

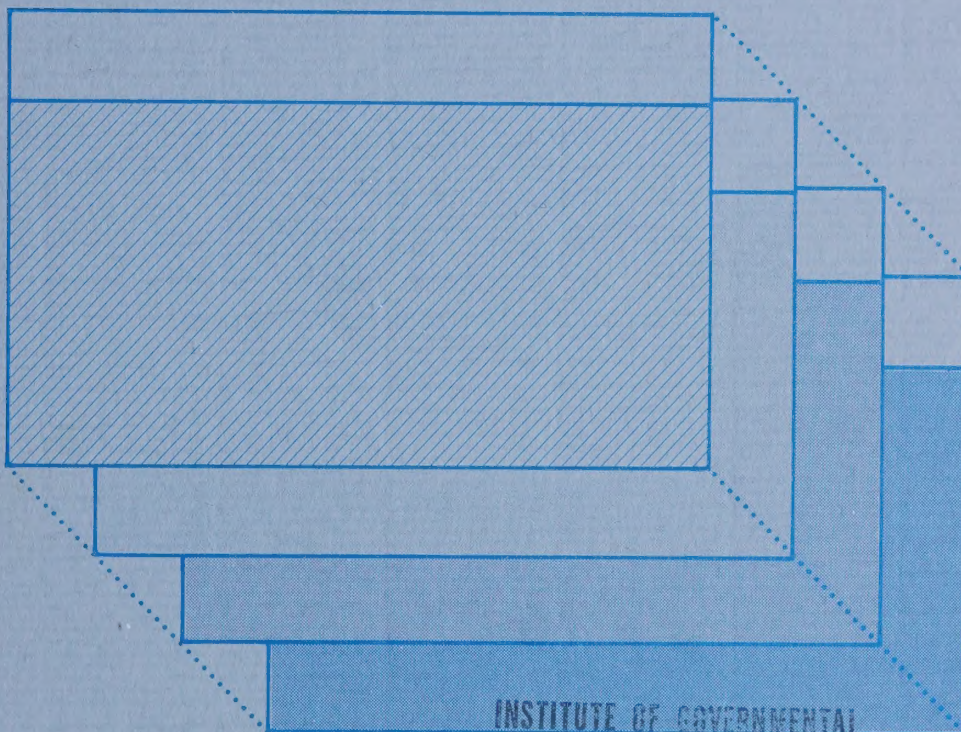
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ENVIRONMENTAL
MANAGEMENT
PLAN
FOR THE
SAN FRANCISCO
BAY REGION

D R A F T

Air Quality Maintenance Plan

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Prepared By



ASSOCIATION OF BAY AREA GOVERNMENTS



BAY AREA
AIR POLLUTION
CONTROL DISTRICT



with assistance from

CALIFORNIA AIR RESOURCES BOARD
LAWRENCE LIVERMORE LABORATORY

CALIFORNIA DEPARTMENT OF TRANSPORTATION
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D E C E M B E R 1 9 7 7

ENVIRONMENTAL MANAGEMENT PLAN
FOR THE SAN FRANCISCO BAY REGION

DRAFT
AIR QUALITY MAINTENANCE PLAN

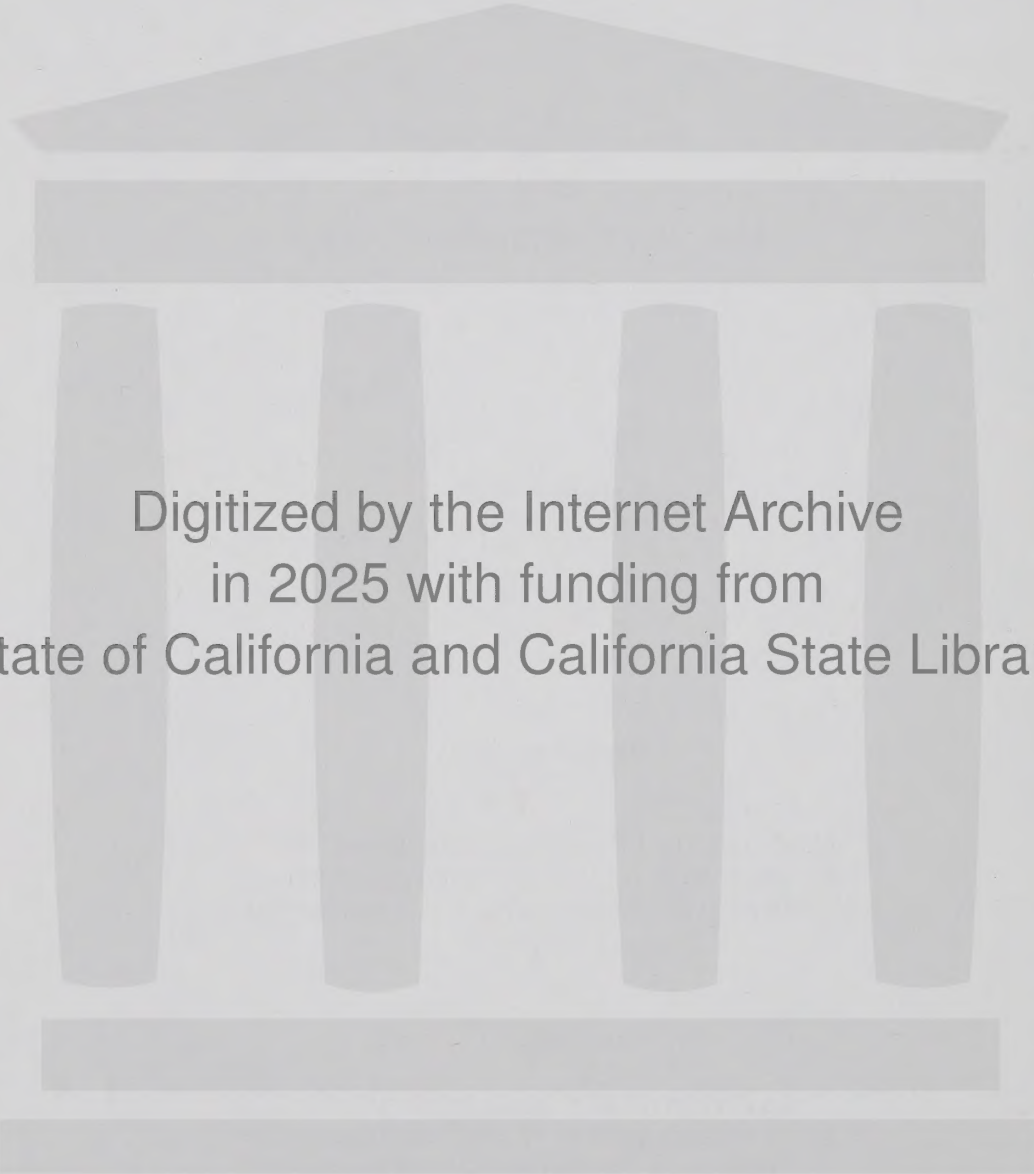
December 1977

Prepared By

ASSOCIATION OF BAY AREA GOVERNMENTS
BAY AREA AIR POLLUTION CONTROL DISTRICT
METROPOLITAN TRANSPORTATION COMMISSION

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Section-1

PURPOSE OF THIS CHAPTER

This chapter describes a plan for dealing with the Bay Area's air quality problems. This Air Quality Maintenance Plan (AQMP) addresses air quality standards set by the State and Federal governments to protect public health. The plan proposes a range of controls to meet air quality standards. It sets forth an approximate time schedule for adopting and implementing these draft proposals if Federal deadlines are to be met. These deadlines are described in the Federal Clean Air Act Amendments of 1977. They require all areas of the country, including the Bay Area, to meet the air quality standards by 1982. Under special conditions, this deadline may be extended to 1987.

The AQMP is summarized in the next section. Sections 3-6 provide background information for the plan and describe the process for developing the proposals recommended. Much of the technical analysis to support the draft AQMP proposals is described in Section 6. Section 7 details the draft plan recommendations. Lastly, Sections 8-10 summarize how the plan is to be implemented and enforced, what benefits and costs are associated with the plan, and what future work should be conducted in the continuing planning process.

The draft AQMP represents a cooperative, multi-agency staff effort over a period of approximately two years. Extensive technical analysis has been conducted to develop the plan. Appendix A provides a bibliography of selected AQMP support documents. Several other appendices containing support materials have also been included. A full report with these and other support materials will be included in the final Environmental Management Plan.

Section-2

SUMMARY OF PLAN RECOMMENDATIONS

This draft plan addresses the problems of air quality. It is required by Federal law. This law--the Federal Clean Air Act Amendments of 1977--requires that all areas of the country, including the Bay Region, must meet established air quality standards by 1982. Under special circumstances for certain kinds of air pollution, the date for meeting the air quality standards can be extended to 1987. The measures needed to meet the standards and the schedule for implementation will undoubtedly cause wide discussion and controversy.

Many consider the Federal Act to be a good one--one that will lead to clean, healthy air in the Bay Area. Others consider the Act to be unrealistic and its requirements impossible to meet. This plan describes what actions would be needed to meet those requirements. The actions are set forth as proposals for satisfying the requirements of the Act. To complete the analysis, the benefits and costs associated with the proposed plan are identified.

INTRODUCTION

The major national impetus for formal air quality planning has been the Clean Air Act of 1970. This Act required each state to prepare state implementation plans for how ambient air quality standards were to be met by 1975, or 1977 at the latest. These Federal air quality standards have been established by the U.S. Environmental Protection Agency (EPA) to protect public health.

For a variety of reasons--technical, political, institutional, and legal--California has never had a completely acceptable (or "approvable") state implementation plan for the Bay Area. One pollutant in particular, photochemical oxidants (sometimes referred to as smog), has posed the most difficult problem for preparing an acceptable plan. Photochemical oxidants consist mostly of ozone (O_3). Oxidant is formed from the reaction of hydrocarbons and oxides of nitrogen in the presence of sunlight. In the Bay Area it is experienced regionwide with the most adverse levels occurring in the summer and fall months. Other air pollution problems also exist, however, and these will be described more fully in the following sections.

AIR QUALITY STANDARDS

Both the EPA and California Air Resources Board (CARB) have established ambient air quality standards to protect public health. Meeting these standards and ensuring their continued maintenance is the basic goal of the AQMP. Because the Federal and State standards are different, the strategies required to meet the two sets of standards are also different. Table 1 presents the Federal and California air quality standards.

Table 1. Federal and California Ambient Air Quality Standards

POLLUTANTS	AVERAGING TIME	CALIFORNIA STANDARDS	NATIONAL STANDARDS ¹
Photochemical Oxidants	1 Hr.	0.10 ppm	0.08 ppm
Carbon Monoxide	12 Hr.	10 ppm	
	8 Hr.		9 ppm
	1 Hr.	40 ppm	35 ppm
Nitrogen Dioxide	Annual Average		0.05 ppm
	1 Hr.	0.25 ppm	
Sulfur Dioxide	Annual Average		0.03 ppm
	24 Hr.	0.05 ppm ²	0.14 ppm
	1 Hr.	0.5 ppm	
Suspended Particulate Matter	Annual Geometric Mean		
	24 Hr.	60 $\mu\text{g}/\text{m}^3$	75 $\mu\text{g}/\text{m}^3$
		100 $\mu\text{g}/\text{m}^3$	260 $\mu\text{g}/\text{m}^3$
Lead	30 Day Average	1.5 $\mu\text{g}/\text{m}^3$	
Hydrogen Sulfide	1 Hr.	0.03 ppm	
Hydrocarbons (Corrected for Methane)	3 Hr. (6-9 a.m.)		160 $\mu\text{g}/\text{m}^3$
Ethylene	8 Hr.	0.1 ppm	
	1 Hr.	0.5 ppm	
Visibility Reducing Particles	1 Observation	In sufficient amount to reduce the prevailing visibility to less than 10 miles when the relative humidity is less than 70%.	

1

National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

National primary standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each State must attain the primary standards no later than 1982. In the case of photochemical oxidants and carbon monoxide, extensions to 1987 at the latest may be granted if certain conditions set forth by the Clean Air Act of 1977 are met.

2

With simultaneous violation of State 1-hour oxidant standard or State 24-hour suspended particulate matter standard.

A brief summary of how each of the Federal and State standards was approached is presented below. It is important to note the distinction between Federal and State standards. Achieving and maintaining Federal air quality standards is required by Federal law; achieving and maintaining California air quality standards is adopted CARB policy. Fixed time schedules and interim requirements have been set for meeting the Federal standards. No such schedules or interim milestones exist for the California standards.

Photochemical Oxidants (Ox)

The Federal standard is more stringent and has been used as the basis for developing control strategies. To meet the Federal standard a comprehensive strategy is recommended, consisting of further technological controls for stationary and mobile sources along with transportation controls and improved land use management.

Carbon Monoxide (CO)

The Federal standards are more stringent than California standards. The 1-hour 35 parts per million (ppm) standard is not currently violated and is not expected to pose future problems. The 8-hour 9 ppm standard is violated in a number of localized areas throughout the Bay Region. Strategies to deal with these problems are best developed on a case-by-case basis. Such individualized strategies have not been conducted as part of the AQMP effort to date. These analyses are scheduled for early 1978 (see Section 10 for a more detailed description).

Nitrogen Dioxide (NO₂)

The Federal standard is an annual average and has never been violated in the Bay Area. The California 1-hour standard is occasionally violated, mostly in the Santa Clara Valley. Because oxides of nitrogen can suppress oxidant formation (see Section 6 for detailed discussion), the control strategy recommended is a cautious one. Further controls of nitrogen oxides are recommended only after a more detailed examination of the problem reveals what the likely sources of the problem are and that the proposed solutions will indeed be effective to deal with the problem.

Total Suspended Particulate (TSP)

Both the 24-hour and annual mean California standards are more stringent than the corresponding Federal standards. In 1975, both Federal and California annual averages were exceeded at a few inland valley areas within the region. Wind blown dirt and dust contribute significantly to total suspended particulate values, raising the important issue of natural versus man-made contributions to the particulate problems. Because the particulate problem occurs in relatively few areas (e.g. Livermore) and natural contributions to monitored values are estimated to be quite significant, no specific recommendations are presented in this document. Until better data are available on the extent and causes of the problem, specific control recommendations should be

deferred. The localized particulate problems should be treated on a case-by-case basis with appropriate controls being developed for each of the localized violations. Like carbon monoxide, particulate problems tend to be quite localized, requiring detailed local analysis of the sources of the problem. Section 10 discusses total suspended particulate problems in more depth. It also recommends a program for developing the data necessary to more fully understand the causes of the problem and possible solutions.

Sulfur Dioxide (SO₂)

The Federal annual average and 24-hour standards are met by a considerable margin in the Bay Region. Recently, however, California adopted a new 24-hour standard which states violations require a simultaneous occurrence with either oxidant or total suspended particulate at violation levels as well. Using this new California standard, the Bay Area does not appear to have a serious sulfur dioxide problem. Because of the unique manner in which California is now defining the sulfur dioxide standard, projecting future problems (and thus possible solutions to the problems) poses special difficulties. These are presented in Section 10 as areas for future research work.

Other California Standards

Unlike EPA, California also has ambient air quality standards for lead, hydrogen sulfide, ethylene, sulfates, and visibility reducing particulates. Each of these pollutants poses problems for control strategy development. A considerable amount of work is needed to define the extent of the problems, inventory sources of the problems, project what future problems will be, and to develop control strategies for dealing with the problems. These tasks are recommended for the continuing planning process and are described in Section 10. It should be noted that the Bay Area Air Pollution Control District has regulations for industrial emissions of lead and hydrogen sulfide.

Summary of Air Quality Standards

Setting air quality standards is a difficult task. It is a dynamic process with standards constantly undergoing review as new medical research becomes available. Some standards change and others are established. For example, during the course of this study, the California Air Resources Board adopted a new 24-hour sulfur dioxide air quality standard. Sometime in 1978, EPA is required to set a new short-term nitrogen dioxide air quality standard (assuming the medical evidence supports the need for such a standard to protect public health).

Under the Clean Air Act of 1977, regular reviews of all air quality standards are required. The Federal standards set under the Clean Air Act of 1970 have remained unchanged despite several independent scientific reviews of these standards in the early 1970's. Regardless of whatever controversy exist with the standards and the levels at which they are established, the standards are set according to Federal and State laws. The AQMP by addressing the standards is addressing Federal law and State policy.

PROBLEMS

In its simplest form, air quality problems are easily defined. The Bay Area is not meeting air quality standards. Both existing and projected problems

are of concern. The previous section which discussed the current standards touched upon the existing problems. Projected future problems are summarized below.

Photochemical Oxidants (Ox)

It is generally agreed that the most difficult air quality standard to meet in the Bay Region is the 1-hour 0.08 ppm photochemical oxidant standard. Hydrocarbon emissions which lead directly to oxidant formation were estimated to be approximately 1000 tons/day in 1975. Under existing control programs, hydrocarbon emissions are projected to decrease by about 20% in 1985 to approximately 800 tons/day. By 2000, the hydrocarbon emissions are again projected to be approximately 1000 tons/day, or roughly the same emission levels as 1975. Thus, since oxidant levels experienced in the Bay Area in recent years reach 2-3 times the standard, one would expect a modest improvement by 1985, followed by a slow deterioration to current oxidant levels again by the year 2000. Oxidants are clearly an existing and projected air quality problem.

Carbon Monoxide (CO)

A number of urbanized areas exceeded the federal 8-hour 9 ppm carbon monoxide standard in 1975, e.g. San Jose, San Francisco, Oakland, and Vallejo. Region-wide emissions were estimated to be about 4300 tons/day in 1975. Future emissions for 1985 and 2000 with existing programs are projected to be about 4000 tons/day and 5700 tons/day respectively. Since emissions are projected to increase significantly from 1975-2000, it would appear that carbon monoxide will continue to be a problem unless additional controls are adopted.

Carbon monoxide is a very localized air quality problem caused almost exclusively by motor vehicle exhausts. Control strategies for existing and projected carbon monoxide problems need to be developed for the specific areas violating the standard. The detailed studies of local carbon monoxide problems have not been conducted to date. Such work is currently scheduled for early 1978.

The Bay Area was not designated originally by EPA as a carbon monoxide problem area. The updated emissions projections would suggest that a closer examination of this non-designation is warranted. A description of the approach proposed is described in Section 10.

Nitrogen Dioxide (NO₂)

Nitrogen dioxide is not currently a major problem in the Bay Area. The federal annual average of 0.05 ppm has never been exceeded. Oxides of nitrogen emissions projected for the region remain relatively constant over the 25 year planning time frame: 731 tons/day in 1975; 692 tons/day in 1985; and 721 tons/day in 2000. Thus, it is not projected that the nitrogen dioxide Federal standard will be violated in the future.

The California 1-hour 0.25 ppm nitrogen dioxide standard is violated several times a year, particularly in the south Bay Area. Technically, the most controversial issue facing the Bay Area is whether or not additional controls of nitrogen oxides should be implemented and if so, what controls are appropriate. This issue is extremely complex. Its resolution has implications for oxidant

control strategies throughout California as well as many other areas of the country. What is recommended in the AQMP is that further nitrogen oxides controls be approached in the Bay Region with considerable caution.

Total Suspended Particulates (TSP)

Both Federal and State 24-hour and annual geometric mean standards for total suspended particulate are violated in different parts of the region with varying frequency. Since the State standards are more stringent, they are violated more frequently. Particulate problems tend to be localized. Thus, a knowledge of the sources contributing to the problem is desirable so that a discriminating and effective control program can be developed.

Devising such control programs is quite complex. There are many sources of particulate matter. From natural sources, particulate matter can come from ocean salt, soil particles, pollen, plant and insect parts. More comes from man's activities, however, from:

- combustion products in domestic, commercial, manufacturing, transportation, and agricultural activities
- rubber tires, brake linings and roadway dust from vehicle movements
- natural dusts raised by mining, quarries, agriculture and construction
- man-made particulate such as sawdust, paint spray and manufactures

All of the particulate sources cited above are primary sources, or particulate matter released directly into the atmosphere. Secondary sources of particulate matter (sometimes referred to as secondary aerosols) can also come from the formation of liquid or solid particulates by reactions of gases in the atmosphere.

Overall, the information currently available to develop an effective and discriminating control strategy for the particulate problem is not available. The data deficiencies are cited in Section 10, along with what information is available. Specific recommendations for work to be conducted to fill these data gaps are proposed. Such work should be completed prior to developing a regional total suspended particulate control strategy.

Sulfur Dioxide (SO₂)

Sulfur dioxide emissions come mostly from the industrialized areas of Contra Costa County. Even here, however, both Federal 24-hour and annual average sulfur dioxide standards are not violated. In fact, the 1975 annual average high for the region was less than 40% of the Federal standard.

Because less natural gas is anticipated, sulfur dioxide emissions are projected to increase substantially in 1985 and 2000. The 219 tons/day estimated for 1975 are projected to increase to 435 tons/day in 1985 and 414 tons/day in 2000. The major factors influencing the projected sulfur dioxide emissions are State and Federal energy policies. For example, if the CARB petition

to the California Public Utilities Commission were granted to allow natural gas from the Bay Area to be diverted to Southern California, sulfur dioxide air quality in the Bay Area would be degraded. Federal energy policies, some of which are currently being debated in Congress, may have other effects. In a separate study, ABAG is currently examining what potential impacts alternative energy policies might have on Bay Area air quality. Draft findings from this study will be available in March, 1978.

The current State 24-hour sulfur dioxide standard was violated once in 1975. By simply examining the sulfur dioxide emission trends, one would expect it will also be violated in the future. However, no model (simple or complex) currently exists to support such a statement. Thus, all that can be said regarding future violations of the State standard is they are likely to occur.

The newly defined sulfur dioxide standard poses special problems for air quality planning and control strategy development, namely:

- Projecting future air quality
- Estimating the effectiveness of control measures

These issues are proposed for detailed examination and resolution in the continuing planning process.

ALTERNATIVE SOLUTIONS

Future air quality improvements can be achieved in a variety of ways. To date, many stationary and mobile source controls have been implemented. Similarly, some transportation and development controls have been instituted to affect air quality. In developing alternative solutions to the existing and projected air quality problems, more than a hundred control measures were examined.

These measures were subjected to a screening by the AQMP Joint Technical Staff and the AQMP Advisory Committee. The measures remaining after the initial screening were examined more closely. As measures were analyzed in more detail, further screening was conducted and control strategies were formed. Section 5 describes in considerable detail, both the process and the results of the analysis of alternative control measures. Alternatives considered but not included in the plan are described with a rationale for why the measures were not included.

THE PLAN

This document is a preliminary plan. More work is still to be conducted. This is especially true for carbon monoxide, total suspended particulate and sulfur dioxide, and other California designated air pollutants. This work will constitute part of the continuing planning process.

The draft plan deals with the two regionwide air quality problems which local and regional governments can most directly influence--photochemical oxidants and nitrogen dioxide. The oxidant problem in particular, cannot be solved without a comprehensive strategy involving all levels of government--local, regional, State and Federal. The oxidant problem is considered

by most to be the most difficult problem facing the Bay Area. Its solution is required by law. The Bay Area, working together cooperatively with State and Federal governments can plan and implement the solutions. Alternatively, the State and Federal government must plan and implement the solutions for the Bay Area.

Recommended Actions

A comprehensive strategy of additional technological controls for stationary and mobile sources and transportation and land use controls is set out in the plan. Some measures are direct, others are indirect. All are needed for meeting and maintaining the air quality standards.

A summary of the measures is provided below. The detailed description of measures and their effects on future air quality is given in Sections 6 and 7. The actions are basically divided according to implementing authority and/or responsibility.

Stationary Source Controls. Two basic programs would be carried out by the Bay Area Air Pollution Control District in the AQMP. Both programs are controversial and will require considerable expenditures, primarily from private industry. These programs are:

- Use of best available control technology (BACT) for new and existing industries.
- A review (and permit program) of new and modified air pollution sources to ensure use of BACT and a determination of the source's contribution to further violations of air quality standards. Permits are issued or denied on the basis of meeting the criteria specified in the Bay Area Air Pollution Control District's regulations. (The District has had some form of new source rule regulation in effect since 1972. It is currently reviewing the rule to consider options such as emission offsets.)

Mobile Source Controls. These programs are basically hardware oriented or technological approaches to reducing vehicle emissions. Three programs are recommended for consideration by the California Air Resources Board. If carried out, these programs would result in lowered emissions from new passenger cars and trucks, periodic inspections of cars to keep them running as clean as possible, and lowered emissions from trucks currently in use.

Transportation Controls. A variety of transportation control measures would reduce the amount of vehicle travel within the region. These would be carried out by many agencies. The programs are a combination of incentives to use transit and carpools and measures to discourage the private use of the automobile. The measures include: increased tolls on bridges, a regional parking strategy, additional transit service, increased bus and carpool lanes with ramp metering, an auto control zone in downtown San Francisco, more ride sharing services (e.g. jitneys and vanpools), and more extensive bicycle systems.

Land Use Management/Development Controls. The objective of the development controls is to reduce the number and length of automobile trips in the region. While directly related to transportation decisions, an important factor

is achieving more compact development throughout the region. Implementation would be by the cities, counties, special districts, Local Agency Formation Commissions (LAFCOs), Metropolitan Transportation Commission, Bay Area Air Pollution Control District, and Association of Bay Area Governments. As one means to ensure or enforce development consistent with compact development, an indirect source review program is proposed. Under this program all major development projects that attract large numbers of automobiles (such as shopping centers, airports, industrial parks) would require an air quality permit.

Effects of the Plan

A number of alternative strategies has been analyzed. A comprehensive strategy, involving controls for stationary and mobile sources as well as land use and transportation controls, has been developed. This strategy includes requiring permits for new, modified, and indirect sources of air pollutant emissions (commonly referred to as the New Source Review and Indirect Source Review rules). These requirements for permits could result in lower emissions than would be the case without new and indirect source review. The permits would be issued on a project-by-project basis. Therefore, the resulting reductions in emissions cannot now be estimated. The reductions will depend on the specifics of the permit regulations. Without considering these reductions, the controls in the comprehensive strategy will almost reduce emissions enough to meet the 0.08 ppm oxidant standard in 1985. The additional reduction in emissions required to meet the standard can be achieved through the application of the new and indirect source review regulations. These regulations provide flexibility to the plan. Initially strict regulations can be changed and relaxed to some degree after it has been demonstrated that steady and further progress is being made toward meeting the air quality standard. As the attainment deadline dates approach and more data are available on air quality trends, these two programs can be reviewed to examine their overall effectiveness and to determine whether the programs should be relaxed or made more stringent.

The AQMP projections in 2000 (without New Source Review and Indirect Source Review), assuming implementation of a comprehensive strategy, show violation of the oxidant standard. Again, continued application of these programs could result in sufficient emission reductions to ensure long term maintenance. Year 2000 projections are inherently subject to greater uncertainty than 1985. Thus, the need for more (or possibly less) controls of hydrocarbons in 2000 can be examined again in subsequent AQMP updates.

Benefits and Costs of the Plan

There are numerous benefits and costs associated with carrying out the plan. The major benefit will be clean, healthy air for the region. This will be especially important to children, elderly, and individuals with respiratory ailments. This plan will virtually eliminate people's exposure to oxidant levels in excess of the standard.

There are other benefits. Tens of millions of dollars will be saved annually from slower deterioration or aging of paints, clothing, rubber goods, and other products. Large savings are estimated for the agricultural industry in the Bay Area for products including grapes, spinach, and flowers.

Implementing the plan would also mean less motor vehicle travel. This in turn would result in significant energy savings, reduced road maintenance costs and fewer traffic accidents. Compact development throughout the region results in similar savings for reduced infrastructure investments, the need for roads, and costs for police and fire protection.

There are direct and indirect costs related to the plan also. Private industry will be required to invest tens of millions of dollars annually for the best available control technologies. The cars produced will have more sophisticated control equipment on them, and will no doubt be more expensive. For older cars, more repairs may be needed following the annual inspection and maintenance check up. Driving the private auto would be somewhat more expensive. This should be partially off-set, however, by fuel savings. Land costs would be expected to rise in certain locations as a result of development controls. Where this happens, housing costs would also rise commensurately.

Overall, large uncertainties exist in the estimates of both the benefits and costs. In some instances, the projected effects will be overstated, and in other cases, they will be understated. A more detailed discussion of these anticipated effects and costs are provided in Section 9.

Section-3

BACKGROUND OF THE PLAN

The Federal Clean Air Act of 1970, and more recently the Clean Air Act Amendments of 1977, set forth a series of stringent requirements for air pollution control. Each state is required to prepare detailed state implementation plans demonstrating how specific air quality standards are to be met. These standards have been set to protect public health. In a similar but separate manner, California has also set ambient air quality standards, again to protect public health. Under California Air Resources Board policy, these standards are to be met as soon as it is reasonably possible.

Many California regions, including the Bay Area, have exceeded some or all of the Federal and State air quality standards. Thus, the need for a plan. The Air Quality Maintenance Plan (AQMP) recommends a regional air quality strategy to meet Federal requirements and adopted State policy.

THE GOAL

When the AQMP planning process began, the Clean Air Act of 1970 was in effect. At that time it was clear that the requirements of the 1970 legislation could not be met, namely the attainment of federal air quality standards by 1977 and maintenance thereafter. Anticipating that amendments to the Clean Air Act of 1970 were soon forthcoming, the Environmental Management Task Force (EMTF) adopted the following goal by resolution in early 1977:

"The goal of the Air Quality Maintenance Plan is attainment and maintenance of Federal and State air quality standards as expeditiously as practicable."

In August of this year, Congress passed and the President signed into law the Clean Air Act Amendments of 1977. The new law, as anticipated, provides additional time for areas with severe air pollution problems to meet the previously prescribed air quality standards. California is now required to provide for the attainment of Federal air quality standards no later than December 31, 1982. The 1977 Amendments do provide in areas with especially severe oxidant and carbon monoxide problems (such as the Bay Region) that the deadline for meeting the Federal standards may be extended to as late as December 31, 1987. This extension can be granted only if all reasonably available control measures have been implemented. For example, a schedule for implementing a motor vehicle inspection and maintenance program is specifically required. In addition, the revised state implementation plan must show "reasonable further progress" and any new or modified stationary sources must operate at the "lowest achievable emission rate" for its industrial category.

AIR QUALITY STANDARDS

As noted previously, two sets of ambient air quality standards exist in the Bay Area. The U.S. Environmental Protection Agency set Federal standards

and the California Air Resources Board has set State standards. Both sets of standards are intended to protect public health from the adverse effects of air pollution. The standards have been summarized in Table 1.

Ambient air quality standards have always been controversial. They have been criticized both as being too permissive (not sufficiently protective of public health) and too stringent (or overly protective of public health). Because the medical research supporting air quality standards is always being updated, these standards are periodically reviewed. Since 1971, when the Federal air quality standards were set, these standards have remained unchanged. During the past six years, several reviews of the Federal standards have been conducted.

The 1977 Amendments require the following actions be taken regarding Federal air quality standards:

- Not later than December 31, 1980, and at five-year intervals thereafter, the Environmental Protection Agency shall thoroughly review the air quality standards and revise them as appropriate. Such reviews may be conducted earlier or more frequently than specified above.
- The reviews described are to be conducted by an independent scientific review committee with recommendations to the Environmental Protection Agency on both new standards and/or revisions of existing standards as appropriate.

The AQMP presented in this document assumes the Federal and State air quality standards shown in Table 1 are to be met. The control strategy implications for meeting both Federal and State air quality standards are presented in Section 6.

LEGAL REQUIREMENTS

In 1976, the Environmental Protection Agency published regulations for the preparation, adoption, and submittal of state implementation plans to deal with long-term maintenance of Federal air quality standards. Basically, these regulations require the following tasks be conducted:

- Projection of emissions into the future
- Allocation of emissions according to estimated projections of location
- Calculation of air quality resulting from the future emission pattern
- Development of a control strategy to maintain the federal air quality standards
- Adoption of regulations to make the control strategy enforceable

The above approach has generally been used in developing the AQMP. In some cases, as noted in Section 7 describing the plan, it has not been possible to complete all of the tasks required. These instances are noted along with a discussion of the air quality issues raised. Section 8 discusses specific requirements set forth by the Clean Air Act of 1977.

PREVIOUS PLANNING

Air pollution control programs, have been actively pursued in the Bay Area since the 1950's. However, the major impetus for formal air quality planning began with passage of the Clean Air Act of 1970. Under this Act, states were given primary responsibility for developing and submitting to EPA a state implementation plan which contained measures to meet Federal air quality standards. If a state failed to submit a plan which was acceptable, EPA was required to prepare such a plan.

In the San Francisco Bay Region, the California Air Resources Board directed the Bay Area Air Pollution Control District to prepare various air pollution control strategies as part of the initial state implementation plan. Based on these controls and others added by the California Air Resources Board, the State of California prepared and submitted its plan to the Environmental Protection Agency in 1972. The plan was found deficient. One of the deficiencies cited by the Environmental Protection Agency in the state implementation plan was the failure to include adequate control strategies for transportation related pollutants--in particular, carbon monoxide and photochemical oxidant.

Following a court decision on the plan's inadequacies, the Environmental Protection Agency directed California to submit a transportation control plan for the Bay Area to reduce auto-related pollutants. The purpose of the transportation controls was to reduce auto emissions to a level which would allow meeting air quality standards. Because of the severity of the oxidant and carbon monoxide problems, transportation control plans were really a misnomer for control strategies dealing with stationary and mobile sources.

The deadline for submitting the transportation control plan in the Bay Area was very short. Acting in response to a court order, the Environmental Protection Agency Administrator in March 1973 notified the Governor of California that a plan should be submitted by April 15, 1973. The tight deadlines, combined with the severe air pollution problems to be dealt with, led to California defaulting on its responsibility to prepare an "acceptable" transportation control plan and state implementation plan.

When California failed to submit a transportation control plan as requested, the Environmental Protection Agency promulgated its own in November 1973. The plan showed that a 97% reduction in travel in the Bay Area would be needed to meet the air quality standards. The Environmental Protection Agency plan included traffic controls, other mobile source emission controls and extensive stationary source controls. To achieve the 97% reduction in travel, limitations on gasoline sales or gas rationing, was proposed. While the Environmental Protection Agency expressed serious reservations about the feasibility of a gas rationing program, it stated the Clean Air Act left the Environmental Protection Agency Administrator with no other legal alternative but to include such a strategy.

Recognizing the unsatisfactory nature of the Environmental Protection Agency plan, the State exercised its option to prepare and substitute its own plan. In the Bay Area responsibility for development of a transportation control plan was delegated to the Metropolitan Transportation Commission. The plan was developed under the direction of the Metropolitan Transportation Commission Traffic Coordinating Council. Membership of this Council is structured to represent the diverse interests of the region.

The plan was completed in early 1975. It was adopted by the Metropolitan Transportation Commission as part of their regional transportation plan. Various transportation control strategies, short and long-term, were presented in the transportation control plan with an analysis of their implications on air quality. Because the plan was unable to demonstrate meeting the air quality standards, it was not accepted by the California Air Resources Board. Transportation controls to reduce the amount of travel within the region decrease in effectiveness as motor vehicle emission controls become more effective. This fact contributed to the State failure to adopt these programs as part of its plan.

In summary, the current AQMP planning effort is intended to satisfy a number of requirements, including:

- Previous deficiencies of the transportation control plan and state implementation plan for meeting air quality standards;
- Federal regulations that strategies developed will show continued maintenance of air quality standards once attained; and
- Recently enacted requirements of the 1977 Clean Air Act for state implementation plan revisions to show attainment of air quality standards by 1982, or at the latest 1987.

EXISTING AND PLANNED PROGRAMS

Many control programs for air pollution currently exist. More are scheduled to be implemented in coming years. Before an examination of potential solutions to our present and projected problems can be conducted, a thorough understanding is needed of existing and planned air pollution programs. These programs have been organized primarily according to implementing authority and/or responsibility.

Stationary Source Emission Controls

In the San Francisco Bay Region, the Bay Area Air Pollution Control District (BAAPCD) has been empowered to control air pollution from stationary sources. Since its formation in 1955, the District has developed air pollution control programs for many categories of stationary sources.

To date the BAAPCD has enacted eight regulations, and six of these affect stationary sources. Some of them directly control air pollution by limiting the emissions of specific pollutants, either on a mass flow rate or concentration basis. Other regulations indirectly control pollutants by curtailing open burning, new source construction and expansion of existing stationary sources. Some sections deal specifically with emissions of odorous substances and others limit the density of smoke which may be emitted to the atmosphere. The regulations of the BAAPCD have been expanded and modified through the years, and are generally acknowledged to be among the most stringent in the United States. A brief description of present regulations follows.

Regulation One, adopted in March 1957, bans backyard trash burning and dump fires. It lists allowable types of fires and limits agricultural burning to favorable meteorology days designated "burn days" by the District.

Regulation Two, first adopted in May 1960, has eighteen different divisions. It includes controls on particulate matter (smoke particles and dust), sulfur compounds, lead, nitrogen oxides, and odorous substances from industrial and commercial sources. Permit and new source review requirements are also included in Regulation 2. The requirement for vapor recovery systems at service stations is part of the permit regulation.

The District's permit requirements, set out in Division 13 of Regulation Two, require anyone wishing to build or expand a source that emits air contaminants to first apply to the BAAPCD for a permit to build, and submit plans and specifications for evaluation by District engineers. Permits to build or modify will be denied if it is determined that the project would not meet any of the District's emission requirements or would cause any air quality standard to be exceeded in the vicinity of the proposed site. A second evaluation is required after the source is built before it can obtain a permit to operate. Division 13 also requires vapor recovery controls for service stations.

Regulation Three, originally promulgated in 1967, was developed to control emissions of organic compounds, in particular "reactive" organics which are relatively quick to react with nitrogen oxides in the atmosphere and form photochemical oxidant. Olefins, substituted aromatics, branched chain ketones and trichloroethylene are examples of reactive organic compounds controlled under this regulation. Regulation Three affects the formulation, storage, shipment and use of such materials as solvents, paint, gasoline and ink.

Regulation Four, June 1971, does not deal with stationary source controls. Now obsolete, it required installation of crankcase emission control devices on certain automobiles.

Regulation Five, adopted March 21, 1974, defines three levels of air pollution episodes and specifies actions to be taken by the Air Pollution Control Officer. Certain corrective control measures are invoked to discourage further buildup of contaminants in the atmosphere. Included in Regulation 5 is a requirement that source operators submit, in advance, standby plans for reducing emissions during air pollution episodes.

Regulation Six, 1974, does not affect stationary sources. It gives members of the BAAPCD vehicle patrol authority to arrest individuals observed to be violating those provisions of the vehicle code relating to automobile emissions.

Regulation Seven, December 1974, sets emission standards for new or modified sources of air pollution, following EPA guidelines. These sources include fossil fuel power plants, larger incinerators, cement plants, acid plants, refineries, smelters and steel plants.

Regulation Eight, December 1974, establishes limits for the emission of asbestos, beryllium and mercury, defined as hazardous pollutants by the EPA. Sources of asbestos are allowed no visible emissions. The beryllium standard limits emissions to not more than 10 grams per 24-hour period. For mercury the limit is no more than 23 grams/24 hours.

Because of the historical development process, the present system of regulations has become somewhat unwieldy. A complete reorganization is presently being studied and is expected to make the regulations easier to understand and apply.

Motor Vehicle Emission Controls

The California Air Resources Board (CARB) is the State agency responsible for coordinating both State and Federal air pollution control programs in California. This responsibility includes regulation of pollutant emissions from motor vehicles and coordination of local programs for stationary source control.

Due to the severity of air pollution problems in California, the federal government gives the State the option of enforcing motor vehicle emission standards which are more stringent than federal emission standards. Thus, while the Environmental Protection Agency takes primary responsibility for motor vehicle emissions control, the CARB can and has adopted and enforced emission standards more stringent than required at the Federal level. This section summarizes CARB responsibilities for mobile source control.

The CARB currently has regulations which control emissions from light, medium and heavy duty gasoline powered vehicles, diesel powered trucks and buses, and motorcycles. In addition, the CARB has in effect various regulations and procedures to ensure that emission standards are met. Table 2 presents current vehicle emission standards adopted by the CARB. Recently enacted federal statutes are also presented for comparison.

Transportation Controls

The following transportation control projects are currently operating in the San Francisco Bay Area. Some were required as elements of the transportation control plan, while others are the result of regional transportation planning.

1. Ramp and Mainline Metering:

I-580 - Beaumont Avenue eastbound on-ramp in Oakland;

I-280 - 5 northbound on-ramps between Winchester Road and Route 85 in San Jose. Wolfe Road on-ramp provides bypass for buses and carpools of 2 or more.

Rt. 101 - 5 northbound on-ramps between Capitol Avenue and Route 17 in Santa Clara County;

Rt. 17 - 23 northbound and southbound on-ramps between Route 9 and Route 101 in Santa Clara County;

Bay

Bridge - In March 1974, an overhead metering system was installed just beyond the toll plaza at a cost of \$350,000. This system has maximized the operational efficiency of the bridge.

Table 2. Federal and California Motor Vehicle Emission Standards

Passenger Cars (Light Duty Vehicles)

Model Yr.	Standard	Test	Emissions (gm/mi)		
			HC	CO	NOx
1974	State	CVS-72	3.2	39	2.0
	Federal	CVS-72	3.4	39	3.0
1975-76	State	CVS-75	0.9	9.0	2.0
	Federal	CVS-75	1.5	15	3.1
1977-79	State	CVS-75	0.41	9.0	1.5
	Federal	CVS-75	1.5	15	2.0
1980	State	CVS-75	0.41	9.0	1.0
	Federal	CVS-75	(0.4)*	7.0	2.0
1981 and After	State	CVS-75	0.41	9.0	1.0
	Federal	CVS-75	(0.4)*	(3.4)*	1.0

* Numbers in parenthesis are estimated 90% reduction from 1970 standards.

Motorcycles**

Model Yr.	Standard	Displacement (D, in cc)	Emissions (gm/km)	
			HC	CO
1978-79	State and Federal	$50 \leq D < 170$	5.0	17
		$170 \leq D < 750$	$5.0 + 0.0155(D - 170)$	17
		$750 \leq D$	14	17
1980-81	State and Federal	$D \geq 50$	5.0	12
1982 and After	State	$D \geq 50$	1.0	12
	Federal	$D \geq 50$	5.0	12

**CARB Bulletin, April 1977; in the amended Clean Air Act of 1977, Section 202 (a) (3)(F) motorcycles are classed with heavy duty vehicles.

Table 2. (Con't) Federal and California Motor Vehicle Emission Standards

Light Duty Trucks

Model Yr.	Standard	Test	Equivalent Inertial Weight	Emissions (gm/mi)		
				HC	CO	NOx
1974	State	CVS-72	All	3.2	39	2
	Federal	CVS-72	All	3.4	39	3
1975	State	CVS-75	All	2.0	20	2.0
	Federal	CVS-75	All	2.0	20	3.1
1976	State	CVS-75	All	0.9	17	2.0
	Federal	CVS-75	All	2.0	20	3.1
1977-79	State	CVS-75	All	0.9	17	2.0
	Federal	CVS-75	All	1.5	15	2.0
1980	State	CVS-75	< 4000 lbs.	0.41	9.0	1.5
	State	CVS-75	> 4000 lbs.	0.5	9.0	2.0
	Federal	CVS-75	All	(0.4)*	7.0	2.0
1981 and After	State	CVS-75	< 4000 lbs.	0.41	9.0	1.0
	State	CVS-75	> 4000 lbs.	0.50	9.0	1.5
	Federal	CVS-75	All	(0.4)*	(3.4)*	1.0

* Numbers in parenthesis are estimated 90% reduction from 1970 standards.

Medium Duty Vehicles (CVS-75 Test)

Model Yr.	Standard	Equivalent Inertial Weight*	Emissions (gm/mi)		
			HC	CO	NOx
1978-79	State	All	0.9	17.0	2.3
	Federal	All (< 6000 lbs.)	1.5	15	2.0
1980	State	All	0.9	17.0	2.3
	Federal	All (< 6000 lbs.)	(0.4)***	7.0	2.0
1981 and After	State	< 4000 lbs.	0.41	9.0	1.0
	State	4000-5999 lbs.	0.50	9.0	1.5
	State	> 6000 lbs.	0.60	9.0	2.0
	Federal**	All (less than 6000 lbs.)	(0.4)***	(3.4)***	1.0

* Federal standards deal with only two categories, those less than 6,000 lbs. (light duty) and those greater than or equal to 6,000 lbs. (heavy duty).

** See heavy duty vehicle standards for heavier vehicles.

*** Numbers in parenthesis are estimated 90% reduction from 1970 standards.

Table 2. (Con't) Federal and California Motor Vehicle Emission Standards

Heavy Duty Vehicles

State Standards (gasoline and diesel)

Model Yr.	HC	Emissions (gm/BHP hr.)		HC + NOx
		CO	NOx	
1974	-	40	-	16
1975-76	-	30	-	10
1977-78 either or	1.0	25	7.5	5
		25		
1979 either or	1.5	25	7.5	5
		25		
1980-82 either or	1.0	25		6.0
		25		5.0
1983 and After	0.5	25		4.5

Federal standards (from Clean Air Act Amendments of 1977)

The Federal standards for 1974-78 heavy duty vehicles are identical to the State 1974 standards.

1979-82 "... shall contain standards (for CO, HC and NOx) which reflect the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year..." Section 202 (a)(3)(B)

1983 and after for HC and CO, 90% reduction from, ..."the actually measured emissions from heavy duty gasoline fueled vehicles or engines, or any class or category thereof, manufactured during the baseline model year (1968)."

1985 and after for NOx, 75% reduction from the average of, ..."the actually measured emissions from heavy duty gasoline fueled vehicles or engines, or any class or category thereof, manufactured during the baseline model year (1972)."

Also, particulate standards are called for in 1981.

The following two projects will be constructed soon:

- Rt. 101 - 5 northbound on-ramps between Route 17 and Fair Oaks Boulevard in Santa Clara County;
- Rt. 101 - Upgrade five northbound on-ramps between Capitol Avenue and Route 17.

2. Preferential Bus/Carpool Lanes on Freeways:

- Rt. 101 - Marin County Exclusive Bus Lanes. In 1972, a 3.9 mile northbound contra-flow exclusive bus lane was opened just north of the Golden Gate Bridge for use during the period 4 to 7 p.m. Approximately 100 buses use the lane, carrying about 4500 persons. In 1974 the project was extended north an additional 3.8 miles when concurrent-flow bus lanes were opened in both directions. Carpools were later allowed to use these lanes.
- Rt. 280 - In October 1975, a two mile bus/carpool lane was opened on southbound I-280 in San Francisco from Sixth Street to approximately one-half mile south of Army Street. Approximately 200 carpools and 12 buses use this lane during the evening peak.
- Rt. 580 - A bus/carpool lane is about to open through the Dublin Canyon. A study of the feasibility of the extending this to the Bay Bridge is underway.
- S.F. - In San Francisco bus lanes are in operation on Post and Sutter Streets between Van Ness and Taylor. Approximately 60 buses use these lanes during the peak periods. Muni has reported improved schedule adherence. A bus lane has also opened along Mission Street.

3. Toll Incentives:

Bay

Bridge - In December 1971, with flow carpool and bus lanes were opened at the westbound approach of the toll plaza. In 1975 carpool tolls were eliminated. During the 6 to 9 a.m. peak period, 430 buses and 2,200 carpools use the priority lane.

San Mateo-Hayward and Dumbarton Bridges - Toll free preferential lanes for buses and carpools were opened on both these bridges. Approximately 52 carpools and 40 buses use these lanes during commute periods.

Golden Gate Bridge - The Golden Gate Bridge District began allowing carpools to use the bridge toll-free in 1976. Approximately 1100 carpools use this lane.

Toll Revenues - AB 664 gave the Metropolitan Transportation Commission authority over the level and use of tolls on the trans-bay bridges. The Commission has recently raised the tolls and is using the excess revenue for transit.

4. Carpool Matching Program:

RIDES - is a program operated by Caltrans District 04 to promote car-pooling in the San Francisco Bay Area. A non-profit corporation funded by Caltrans, the Federal Energy Administration and Metropolitan Transportation Commission, is currently being set up to expand this program. A survey conducted in 1975 indicated that approximately 5000 persons had formed carpools as a result of the program.

5. Improvement of Transit Service:

AC/BART - Coordinated Fare - The AC/BART transfer system provides for free transfers from BART to AC.

MUNI/BART Coordinated Fare - The MUNI/BART transfer system provides two tickets for MUNI bus rides for 25¢, a savings of one-half the full regular fare.

Santa Clara - Santa Clara Transit District was formed in 1972. Operations commenced in 1975 with 233 buses. The District also operated 9 buses for "Commute Specials"--these are used by some of the corporations.

Bus Pre-emption - A bus pre-emption system is to be installed along a portion of Almaden Expressway. Twelve signalized intersections are involved. The traffic signal equipment is under construction.

San Mateo County - San Mateo Transit District was formed in 1974 and operations commenced in July 1976. Two hundred buses provide service to and within most cities in San Mateo County including a connecting service between most cities in San Mateo County including a connecting service between the Daly City BART station and San Francisco Airport. Buses also served Southern Pacific Stations in the county.

Marin County - In 1970 Golden Gate Transit introduced a new ferry service between Sausalito and San Francisco. Additional service was added in December 1976 between Larkspur and San Francisco. Two additional ferries have gone into service this year.

Napa County - Napa County introduced a Dial-A-Ride system which is designed to provide local transit service in three communities: St. Helena, Calistoga and Napa. The service is provided using one bus.

Sonoma - Mini-bus operates in Sebastopol. Transit service in Santa Rosa is provided by 13 buses, which operate approximately 40 minutes apart.

Solano - In August 1975, the City of Fairfield implemented a Dial-A-Ride program using 5 vans. The service area is seven square miles with a population of 40,000.

AC Transit - AC Transit now provides contract city services in Concord, Pleasant Hill, and Moraga/Orinda. AC Transit also connects with Santa Clara County Transit District buses at Fremont BART station.

6. Preferential Parking:

San Francisco - Caltrans is in the process of leasing 4 state parking lots for carpool use. There would be 580 stalls available, open only to carpools of 3 or more. The fee would be not more than \$10/month.

The experience with transportation programs is valuable. The carpool incentives seem to be successful. The transit additions are also rather significant, but the problems of financing are becoming critical. Despite these incentives, auto travel has not really decreased. This would indicate that some combination of auto restraints and more transit/carpool incentives is needed.

Land Use Management/Development Controls

This term as traditionally used is a misnomer since measures dealing with land use, or land development, include a wide array of non-regulatory devices from the general plan of cities and counties to the service commitments of special districts. The more current and more widely used term "growth management" also means many different things in many different jurisdictions. Hence, in the ABAG Environmental Management Plan we use the terms "development policy" or "development strategy" to signify the land development objective sought, and the term "policy instruments" to mean the measure or tools of implementation.

Land Development Policy As Currently Carried Out in the Bay Region. The implementation of land development policy includes the wide array of things local governments are doing to accommodate the growth as they individually foresee it. Development policy in each locality is a function of what local governments--cities, counties, and service districts--are doing with their legal and fiscal tools to regulate or manage land development. It is also how they support developments with essential urban services such as sewers, water, and roads. Information on the current operating policies of local service providing and regulatory agencies was inventoried in ABAG's 1976 Local Development Policy Survey.

Development policy in local jurisdictions of the Bay Region means more than the general plans of cities or counties. The general plans and their zoning counterparts have been supplemented by capital improvement programs, special tax programs (e.g. Williamson Act Agricultural Preserves), specialized regulations in hazardous areas (e.g., slopes and flood plains), building permit allocation programs, and other programs. In some cases cooperative programs are in effect among cities, counties, and special districts to apply their individual policy instruments jointly to accomplish common development and service objectives.

ABAG Series 3 Projections of Population, Employment and Land Use. ABAG has used the inventory of local development policy as an important part of its Series 3 projections. The projections indicate what the short and long term changes are likely to be in the region if current local land development policy continues unchanged to 2000.

The Series 3 Projections account specifically for a wide array of local growth management programs. This was accomplished by a three phase survey conducted jointly by ABAG and the nine Bay Region counties. The ABAG 1976 Local Development Policy Survey contacted almost 400 local agencies including about 200 city agencies, 73 county agencies, and 125 independent special districts. Seventy-seven of the Bay Region's 93 cities responded along with 52 county agencies and 59 independent special districts. The results from the mail-back questionnaire were used to identify the key policies and policy instruments for in-depth examination in subsequent interviews.

Table 3 summarizes the results of the questionnaire survey. It presents policy instruments now in use to support development, constrain development, or both. On the basis of the number of jurisdictions using them, without regard to the size of the jurisdictions, the following general conclusions are noted:

- a) Among development supporting instruments, assessment districts, redevelopment programs, and capital improvement programs for transportation, sewer, and water systems are the most common. Redevelopment incentives such as tax incentives or other special land reserves with service commitments are relatively rare but do exist as precedents for more widespread application in the region.
- b) Among development constraining instruments open space zoning (and easements), public land acquisition, sewer connection limits and zoning moratoria are most prevalent; numerically transportation access limits, building permit moratoria, and prime agricultural land preserves are of secondary importance.
- c) In the category of instruments that can be used to constrain or support development, the LAFCO spheres of influence dominate (see summary below).

Implications of Regional Growth on Current Development Policy. The implications of regional growth on current development policy are documented at length in the ABAG report on the Series 3 Projections. In summary, development policies concerning industrial growth are out of balance with those related to residential growth. Industrial land reserves far exceed the projected need to 1990. Residential land reserves based on service commitments and regulations are insufficient for the apparent need beyond 1990, assuming the highest probable regional growth trend; and insufficient in some areas even assuming the lowest probable regional growth trend.

These projected trends indicate the importance of development timing and how timing controls are important in developing regional land use alternatives for air quality improvements.

Table 3. Summary of Land Development Policies in Effect - Bay Region 1975

Land Development Policy Instruments (In rank order by frequency regionwide within group)	Number of Jurisdictions Using			
	Total Active	Prior to 1970	1970 to 1975	Expect by 1977
<u>Group 1 Supporting Development</u>				
Assessment (Improvement) Districts	34	30	4	1
Public Assisted Housing Programs	25	12	13	2
Redevelopment Programs	15	7	8	8
Transportation Extension C.I.P.	21	16	5	4
Sewer Extension Capital Improvement Program	14	10	4	5
Public Housing Programs	9	6	3	1
Water Extension Capital Improvement Program	8	8	0	1
Low Income Housing Program	8	3	5	6
Special Service Commitments	6	5	1	2
Sale of Public Land	6	5	1	0
Industrial/Commercial Land Reserve (other than zoning)	0	0	0	3
<u>Group 2 Neutral or Mixed (used to support or constrain Development)</u>				
City Spheres of Influence (by LAFCO)	39	12	27	0
Development Fees	37	27	10	1
User Charges	32	27	5	0
Cluster Zoning	28	21	7	3
Slope/Density Zoning	21	6	15	6
Plan Conformance Rezoning	19	1	18	14
Mass "Up" or "Down" Zoning	11	1	10	8
Development Rights-Purchase or Transfer	8	5	3	4
Land Banking	3	-	3	2
Development Sequence Zoning	4	4	0	4
"Floating Zones"	3	3	0	3
<u>Group 3 Constraining Development</u>				
Open Space Zoning	26	5	21	8
Open Space Easements	23	5	18	4
Zoning Moratorium	18	8	10	5
Sewer Connection Limits	20	9	11	3
Land Acquisition for Public Use	20	12	8	1
Prime Agricultural Land Preserves	11	5	6	1
Building Permit Moratorium	11	0	11	0
Watershed Protection Program	13	8	5	1
Transportation Access Limits	12	7	5	2
Water Connection Limits	7	4	3	3
Other Utility Connection Moratorium	7	7	0	0

Source: Preliminary tabulations ABAG Local Policy Survey, 8/15/76. 65 cities reported of 76 responding. Special districts not included.

HOW THE PLAN WAS PREPARED

A variety of agencies implement programs for controlling air pollution. Many other agencies directly or indirectly influence air quality through public decisions. Future air quality in the region will continue to be affected by Federal, State, regional and local actions regarding:

- The kinds of cars we drive
- The amount and type of industry in the region
- Infrastructure investment decisions for roads, sewers, and water
- The location of jobs and housing
- The level of public transportation available

With this as background, it is evident that an implementable AQMP has to involve those individuals, groups, and agencies directly affected by the plan. In particular, the plan has to involve those agencies primarily responsible for implementing and enforcing the plan's recommendations. A constraint is the program must be manageable to complete the work program tasks within a reasonable amount of time.

The AQMP was prepared by a Joint Technical Staff made up of staff from five agencies. The Association of Bay Area Governments (ABAG) assumed overall program management responsibilities. The Bay Area Air Pollution Control District (BAAPCD) and Metropolitan Transportation Commission (MTC) provided direct support to ABAG under contract. The California Air Resources Board (CARB) and Caltrans provided in-kind staff support for the duration of the study.

Overall guidance to the AQMP-Joint Technical Staff came from several groups:

- Interagency Management Committee - Upper level management representatives from ABAG, BAAPCD, and MTC met periodically to review the progress of the study and provide program guidance as needed.
- AQMP-Advisory Committee - An independent advisory committee with broad regional representation was established to critique and review the AQMP efforts. This body also provided the opportunity for any interested individuals or groups to comment on the development of the AQMP.
- Program Review Board - This group of Federal and State agency officials reviewed progress of all management plans being developed, including the AQMP. Overall program policy guidance was given as requested or needed.

In addition to the AQMP-Joint Technical Staff, specialized air quality modeling assistance was provided in two ways:

- Consultant contracts with the Lawrence Livermore Laboratory (staff support) and the Lawrence Berkeley Laboratory (computer support)
- An air quality modeling committee was established to review and critique the air quality modeling work. This committee was composed of modeling

experts from the California Air Resources Board, U.S. Environmental Protection Agency, Lawrence Livermore Laboratory, Bay Area Air Pollution Control District, Metropolitan Transportation Commission, California Department of Transportation, Systems Applications, Inc. (air quality modeling consultant), and Association of Bay Area Governments.

Overall, the AQMP represents the work of a number of agencies drawing upon many specialized disciplines. The staff and data resources used to prepare the plan have been considerable. Both the process and the results of the planning effort are documented in various technical memoranda, issue papers, and briefs. Because of budgetary constraints, more specialized reports and memoranda have not been widely produced and disseminated. Individuals interested in detailed aspects of different parts of the AQMP should contact ABAG for further information.

Section-4

THE PROBLEMS, CAUSES AND FUTURE PROSPECTS

Any problem should be well defined before solutions are developed to solve it. Thus, prior to developing air quality control strategies, it is important to:

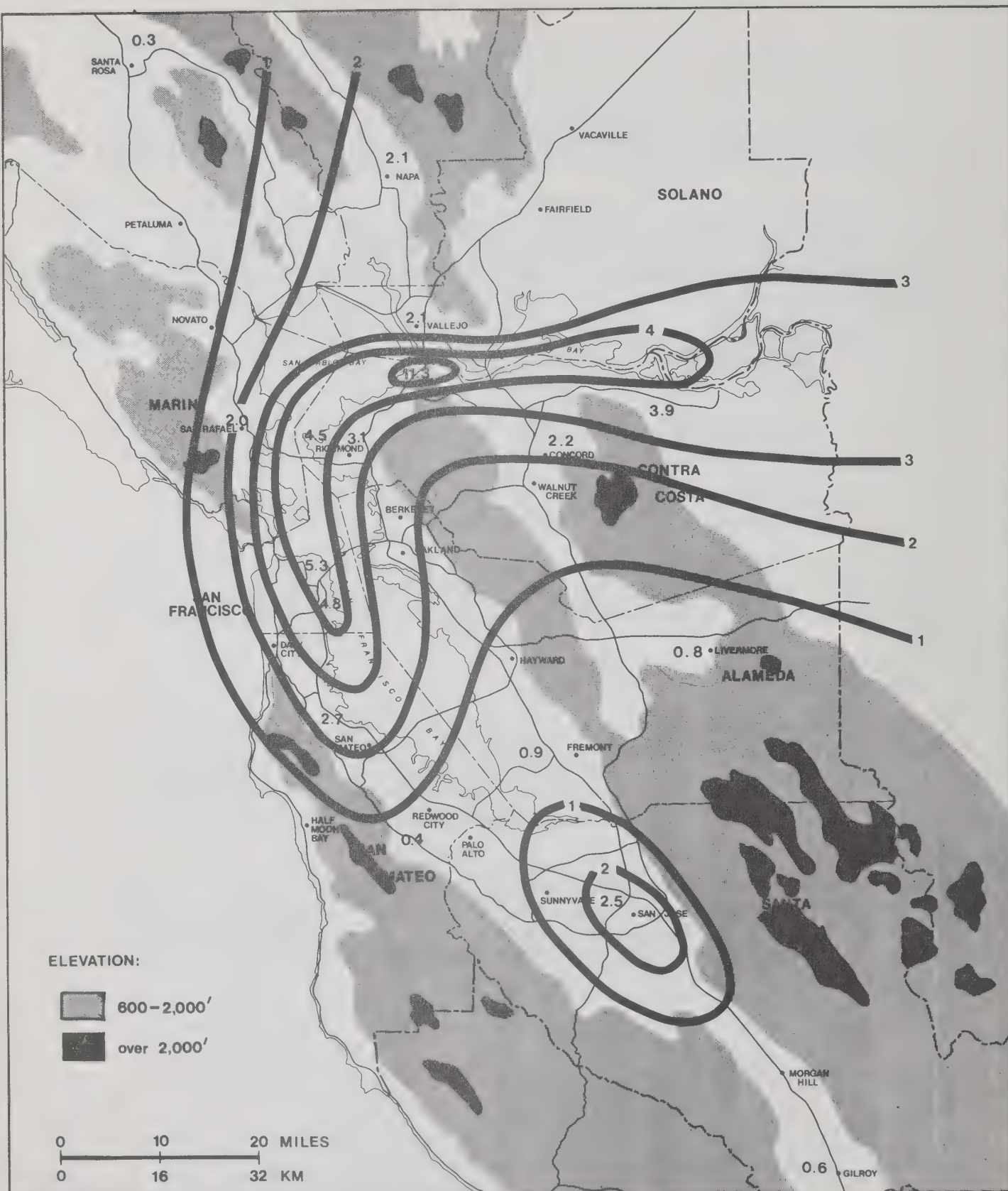
- Define the problem, or assess what past and present air quality levels have been with respect to air quality standards.
- Survey the causes, or inventory past and present emissions contributing to the problem.
- Assess future prospects, or project what future emissions and air quality are likely to be.

If future problems are projected, control strategies clearly need to be developed. This chapter defines what the magnitude and extent of future problems is likely to be and what the principal causes of the problem are.

PAST AND PRESENT AIR QUALITY

The Bay Area Air Pollution Control District maintains and operates an extensive air quality monitoring network throughout the region. Data are collected regularly for pollutants which have air quality standards established. These data are periodically summarized and by reviewing annual reports, it is relatively straightforward to define current problems.

The five pollutants of greatest interest to the region are sulfur dioxide (SO_2), total suspended particulate (TSP), carbon monoxide (CO), nitrogen dioxide (NO_2) and photochemical oxidants (Ox). Brief summaries of what past and present (1975-76) air quality levels were experienced in the Bay region are given below.



1975 Annual Average Sulfur Dioxide Values in parts per billion (ppb). Federal standard is 30 ppb.

Figure 1

Sulfur Dioxide

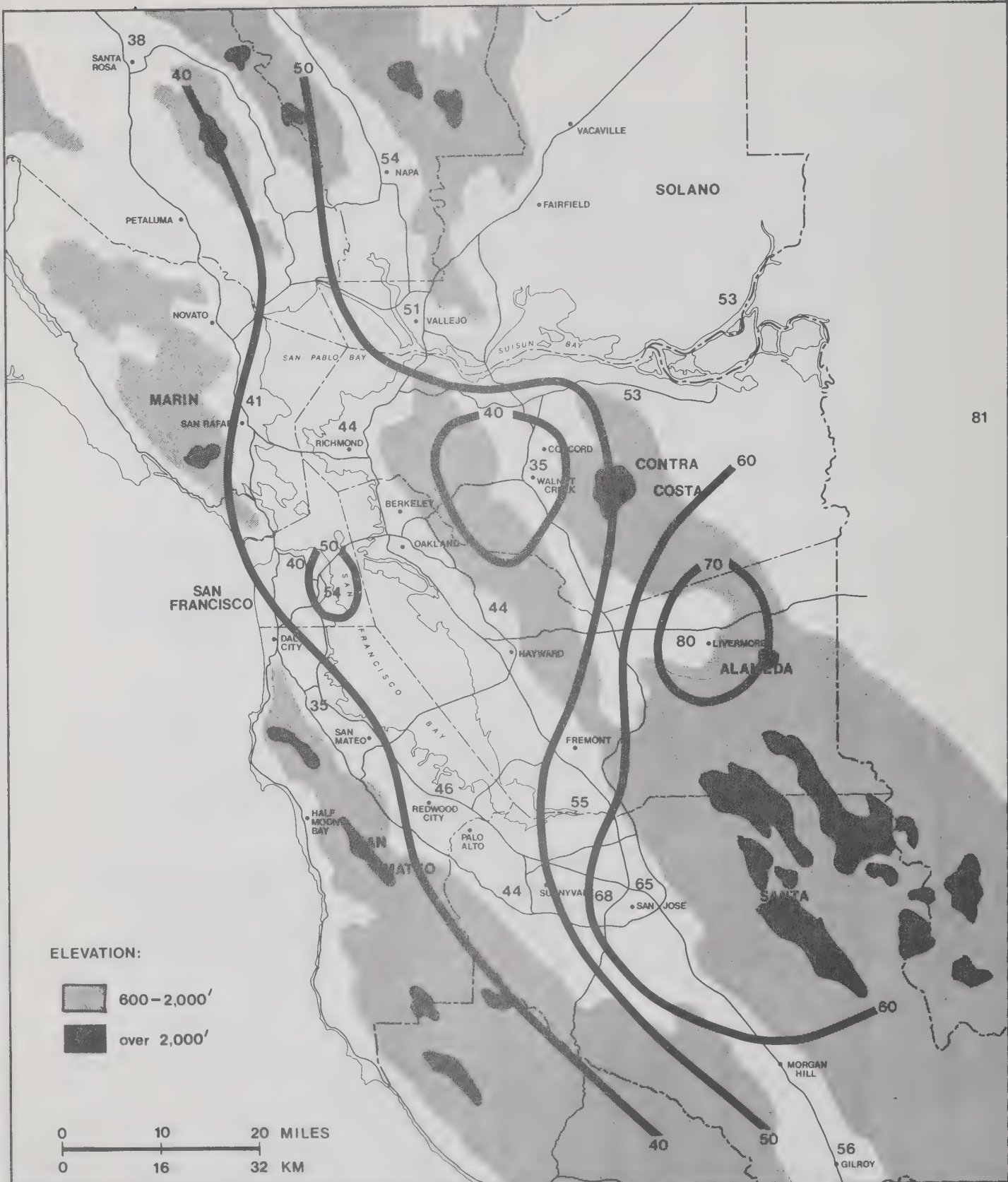
The map of annual average sulfur dioxide values for 1975 shows a relatively narrow band exceeding 3 parts per billion (ppb) centered on the shores of Contra Costa County with extensions to the San Francisco Airport and into the Delta. The Federal standard for sulfur dioxide (SO_2) annual average is 30 ppb, thus most of the Bay Area has less than one-tenth the SO_2 levels allowed by the Clean Air Act. The annual average for all District stations is 2.1 ppb, or 7% of the Federal standard.

The regional maximum of 11.3 ppb is recorded at Crockett, near a chemical plant which manufactures and ships SO_2 as its major product. Even here the annual levels are 60% below the Federal annual standard and encompass a small largely unpopulated area. The one 1975 excess of the State one-hour standard (.5 ppm, or 500 ppb) occurred at Crockett in July. However, there were numerous excesses of the District 3-minute regulation, which has a time frame 20 times more restrictive than the State standard and 60 times more restrictive than the Federal standard.

This annual average is a composite of varying seasonal patterns. In July and August, for example, the highest SO_2 values are at Pittsburg and the Delta, associated with summer air flow patterns. In December and January, drainage flow from the Central Valley along the Contra Costa shore carries the maximum SO_2 averages to San Francisco. A minor secondary maximum over San Jose occurs in September and October, apparently related to local food processing.

The SO_2 in the atmosphere is eventually considered converted to sulfate after extended residence and travel time, and a State sulfate standard of $25 \mu\text{g}/\text{m}^3$ has been established. For 7 years the District has also monitored sulfate and has recorded only one excess of this standard. The pattern of highest sulfate corresponds very closely to that for SO_2 , with mean values over $3 \mu\text{g}/\text{m}^3$ in an arc along the Contra Costa shoreline.

The 1975 SO_2 average is 63% lower than that for 1969 when this monitoring program began. Despite the energy-related fuel-switch problems of 1973-74, the 3-year average for 1973-75 is 39% lower than that for 1969-71, due to stringent District control of major point sources. Projected decreases in global availability of clean fuels suggest increasing difficulty in maintaining the current low levels of sulfur gases.



1975 Annual Geometric Means of Total Suspended Particulate in $\mu\text{g}/\text{m}^3$ (by hi-volume method with fiberglass filters). Federal primary standard is $75 \mu\text{g}/\text{m}^3$. State standard is $60 \mu\text{g}/\text{m}^3$.

Figure 2

Total Suspended Particulate

The annual geometric means (AGM) of total suspended particulate (TSP) show a pattern of low values near the coast increasing with distance inland, particularly into dry sheltered valleys. The values are given in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) which is a measure of weight. The Federal primary standard, expressed as an annual geometric mean is $75 \mu\text{g}/\text{m}^3$ and the State standard is $60 \mu\text{g}/\text{m}^3$. In 1975 the Santa Clara and Livermore Valley areas exceeded the State standard, and the Livermore Valley also exceeded the Federal standard.

The most respirable and visibility-reducing particles are very small, with diameters of 0.1 - 0.5 microns (or 0.0000039 - 0.0000197 inches), and their contribution to total weight is small in relationship to their significance. (One 5 micron particle affects the TSP value as much as 1000 of the 0.5 micron particles). Thus this standard is not an ideal guide to particulate problems. Seven years of District particulate species data show that large silicate particles contribute heavily to the TSP values at our more inland stations such as Livermore.

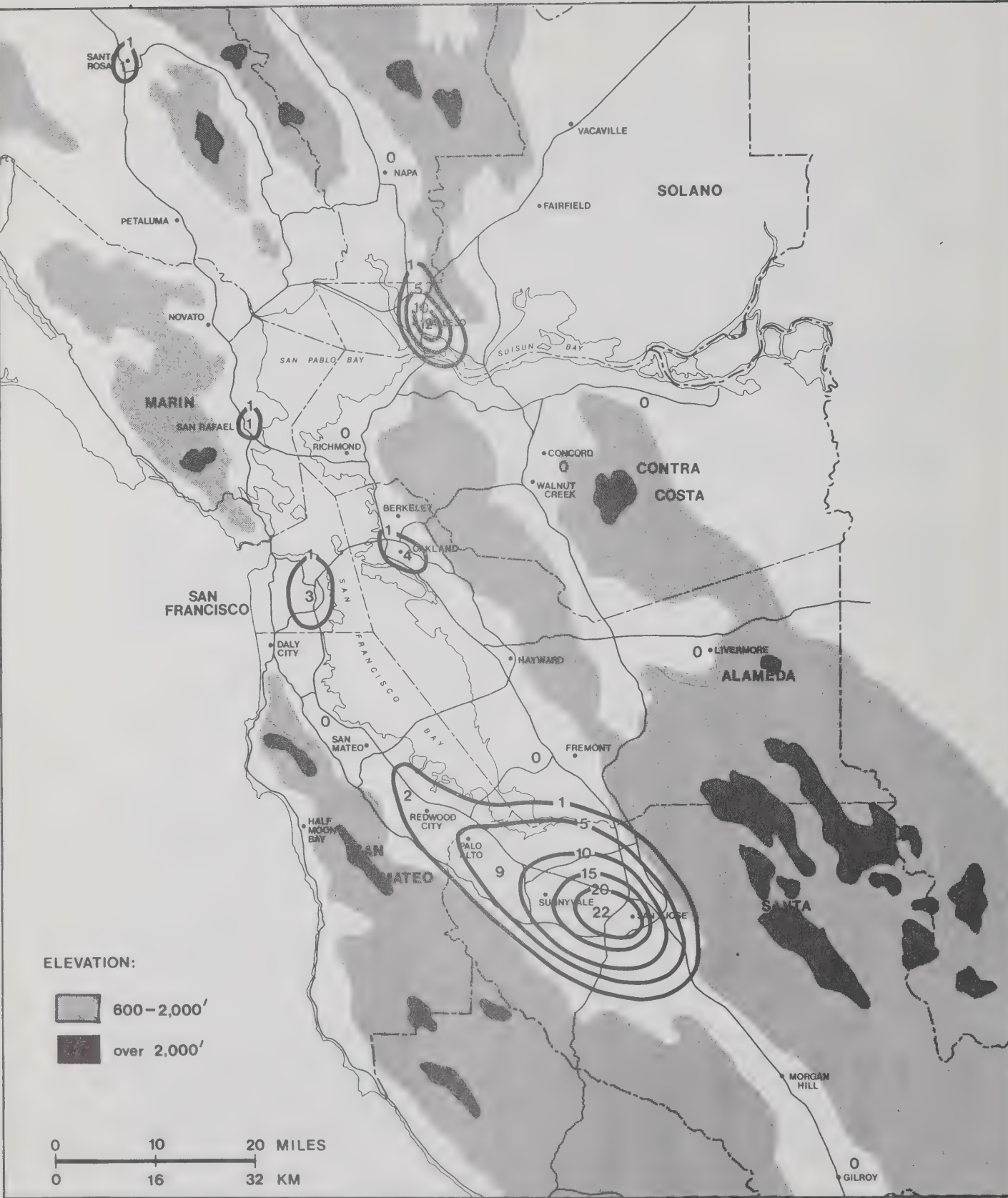
Another widely employed but less precise measure of particulate is the Coefficient of Haze (COH) method, for which no standards have been established, but which relates much better to visibility reduction. Here it is interesting to compare the 1975 COH and TSP annual geometric means for three District stations:

	<u>TSP, AGM</u>	<u>COH, AGM</u>
Sunnyvale	44	0.27
Livermore	80	0.27
Richmond	44	0.14

Sunnyvale has low TSP but high COH, indicating relatively numerous small, but few large particles; Livermore is high in both categories, and Richmond low in both categories. One may hopefully anticipate a Federal standard which better defines the real particulate problem.

One particulate species of particular concern has been lead. The District's annual average lead concentration has fallen from $1.30 \mu\text{g}/\text{m}^3$ in 1970 to $0.70 \mu\text{g}/\text{m}^3$ in 1975 or a decrease of 40%. The switch to non-leaded gasoline is primarily responsible for this improvement.

This decrease in lead values is not closely reflected in total particulate values, which have varied widely from year to year and station to station although an overall downward trend has been noted. Construction activities near a station tend to raise its TSP annual geometric mean for that year. Pittsburg, for example, had a TSP mean of 41 in 1972, 65 in 1973 and 50 in 1974, impacted by major construction in 1973.



1975 Annual Number of Days with Carbon Monoxide Exceeding Federal Standard (9 parts per million for 8 hours).

Figure 3

Carbon Monoxide

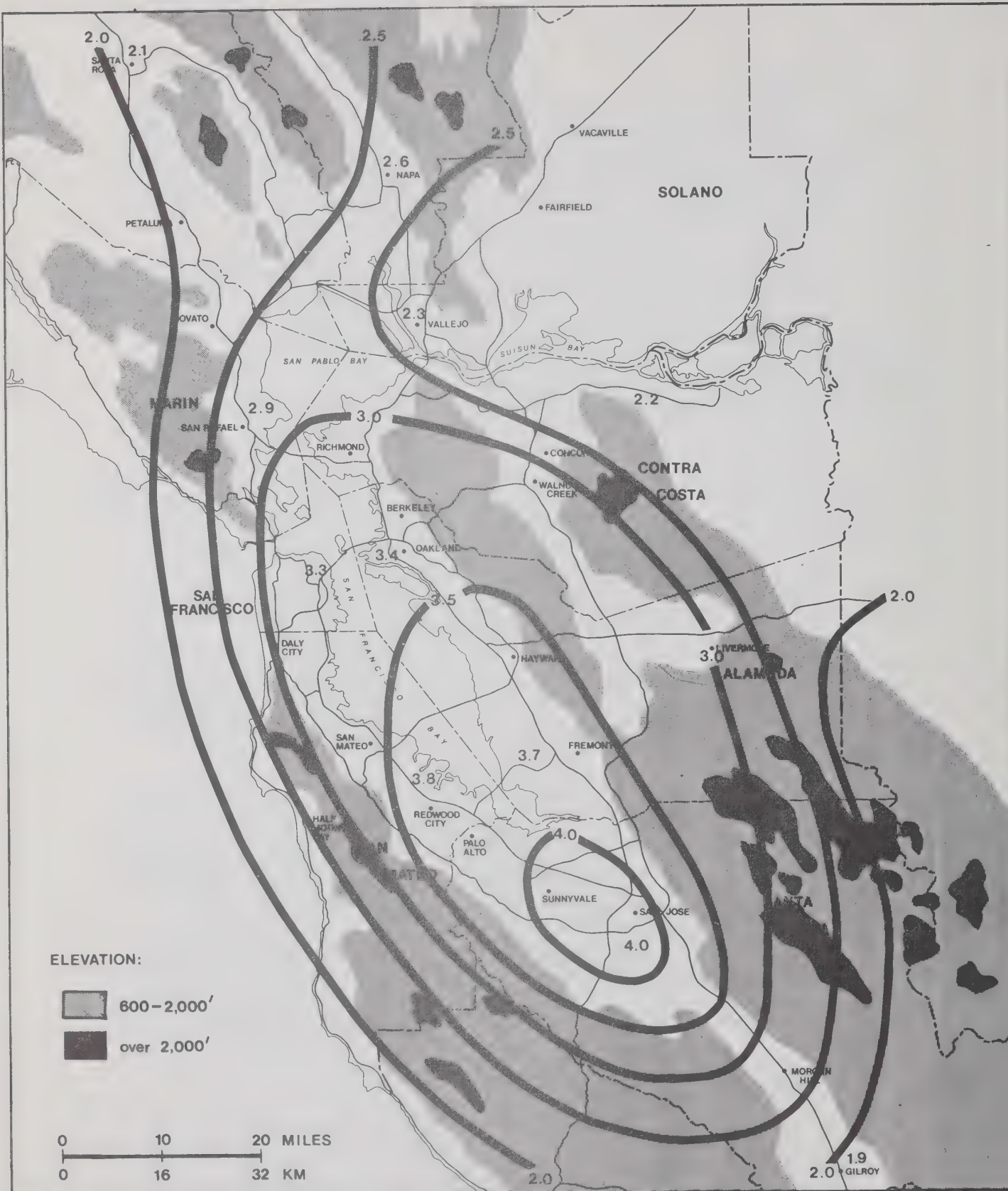
Maps of annual average values as drawn for the previous pollutants are of little value for carbon monoxide (CO) since over 90% of the CO is emitted from vehicular sources resulting in a complex latticed pattern corresponding closely to highway networks. These tail-pipe level emissions are also particularly sensitive to low-level radiation inversions, resulting in very strong daily and seasonal cyclic variations.

Despite the large tonnage of CO emissions, the Federal and State one-hour CO standards have not been exceeded in the current decade. However, the Federal 8-hour average standard of 9 ppm has been frequently exceeded in some areas. The accompanying CO map shows the number of days in 1975 with such excesses. The major excess area is the Santa Clara Valley, centered on San Jose and extending to Sunnyvale. There is a small secondary maximum over Vallejo, and isolated urban-center cases at San Francisco, Oakland, and San Rafael.

To explain this peculiar pattern, one must examine the seasonal and daily cycles in the data. In the past 6 years there has been no CO excess from March through August. Over 80% occur in November, December, and January. On a daily basis over 90% of these 8-hour excesses occur between 4 p.m. and 2 a.m. There is an intense but short maximum from 7 to 9 a.m., followed by low levels from 10 a.m. to 4 p.m. Then, since the winter-season formation of surface-based radiation inversions corresponds to the evening traffic maximum, the sustained build-up of high CO levels occurs. There is also a day-of-week factor, with greatest frequency of excesses on Friday, the maximum vehicle use day. Typically, the District's highest CO values are recorded near 11 p.m. on Friday nights in downtown San Jose. Hopefully, this targeting of the excesses in time and space may suggest the most precise and cost-effective control strategies.

The Santa Clara Valley on a "meso-scale" and the Vallejo station on a "micro-scale" show a strong "drainage pool" effect. That is, the light surface winds under the radiation inversion drain downslope (as water would) and collect pools of contaminants. The Vallejo station appears to be in such a micro-scale pool impacted by Interstate 80. This effect may have implications for land use planning and highway design.

The District average CO data have shown an 11% decrease from 1970 to 1975. Measured ambient CO levels have decreased less rapidly than total emission, apparently because the ambient values in this air basin are most sensitive to winter evening driving modes and patterns.



1975 Annual Average Nitrogen Dioxide Values in parts per hundred million (pphm). Federal standard is 5.0 pphm.

Figure 4

Nitrogen Dioxide

The map of annual average nitrogen dioxide values has the most straightforward pattern of any contaminant, showing a large maximum centered over the Santa Clara Valley. The only Federal NO₂ standard is for the annual average with a limit of 5.0 ppm. The District has never exceeded this Federal NO₂ standard, but San Jose and Sunnyvale are within 80% of it, while Santa Rosa and Gilroy at the lower bounds are near 40% of it.

Nitrogen dioxide is most important as a factor in the photochemical smog formation cycle, but is also a major factor in the dirty brown discoloration of the air. A State one-hour standard of 25 ppm has also been established (near the discoloration level). In 1975 this State standard was exceeded only once, at the Fremont station.

Since the full activation of the District's NO₂ monitoring program in 1968, the District-wide annual average has decreased 11%, but here an examination of individual stations is more elucidating. San Francisco has fallen from 4.0 to 3.3 ppm for a decrease of 18%, but San Jose has risen 3.8 to 4.0 ppm, for an increase of 5%.

The NO₂ develops in the atmosphere from nitric oxide (NO), a primary emission from motor vehicles. An examination of the NO changes helps to explain the NO₂ changes. From 1968 to 1975 the annual NO averages at San Francisco have decreased 49%, while those at San Jose have increased 20%. The Santa Clara Valley now appears to be the principal source area for this contaminant, rather than a receptor area as was more nearly true a decade ago. Independent data of total vehicle-miles by county tend to confirm the current primacy of Santa Clara County.

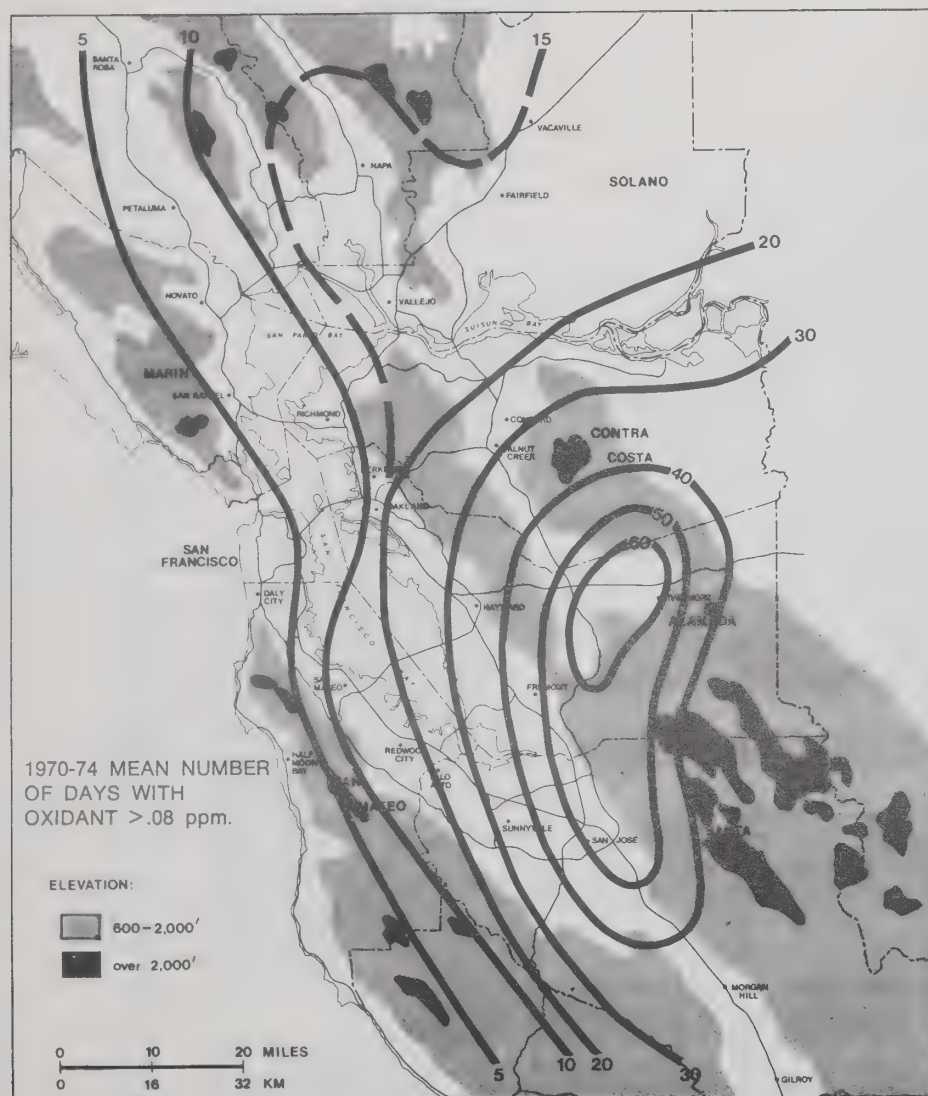


Figure 5a

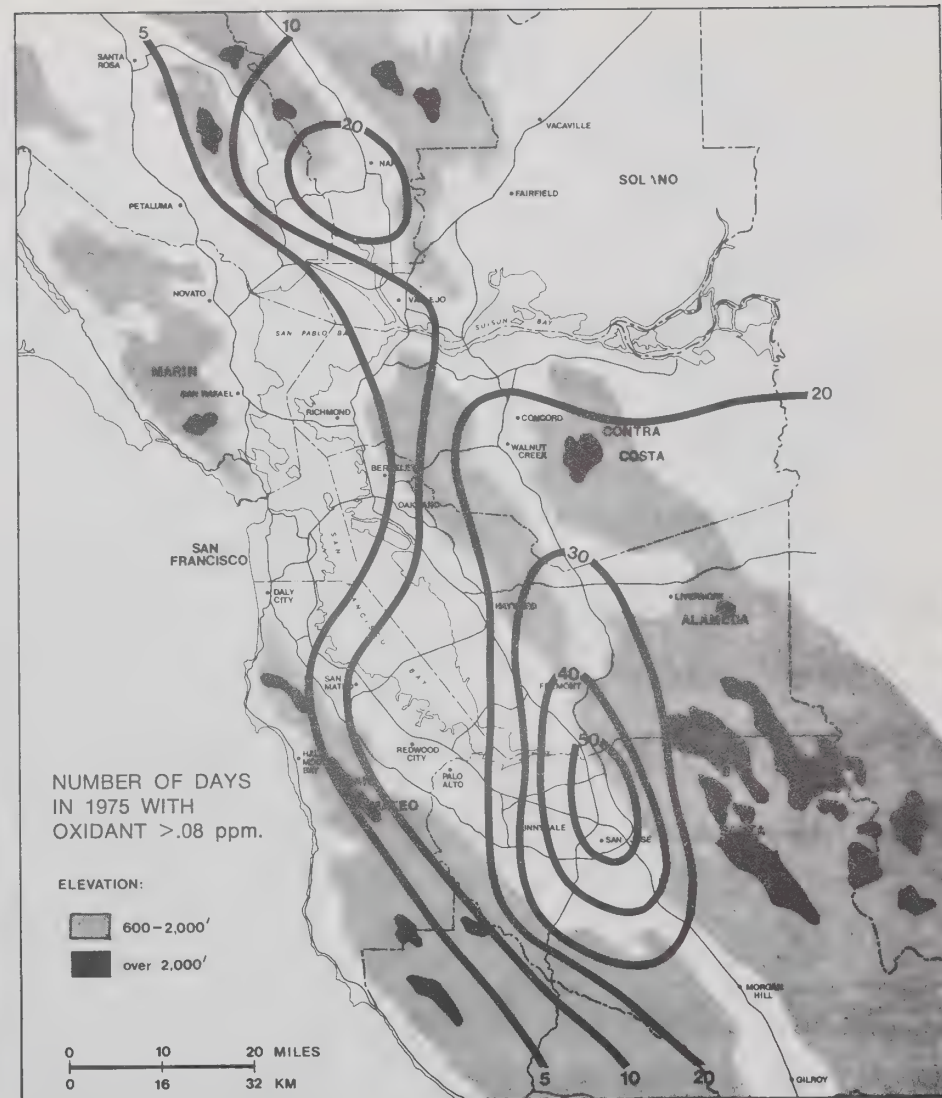


Figure 5b

Photochemical Oxidants

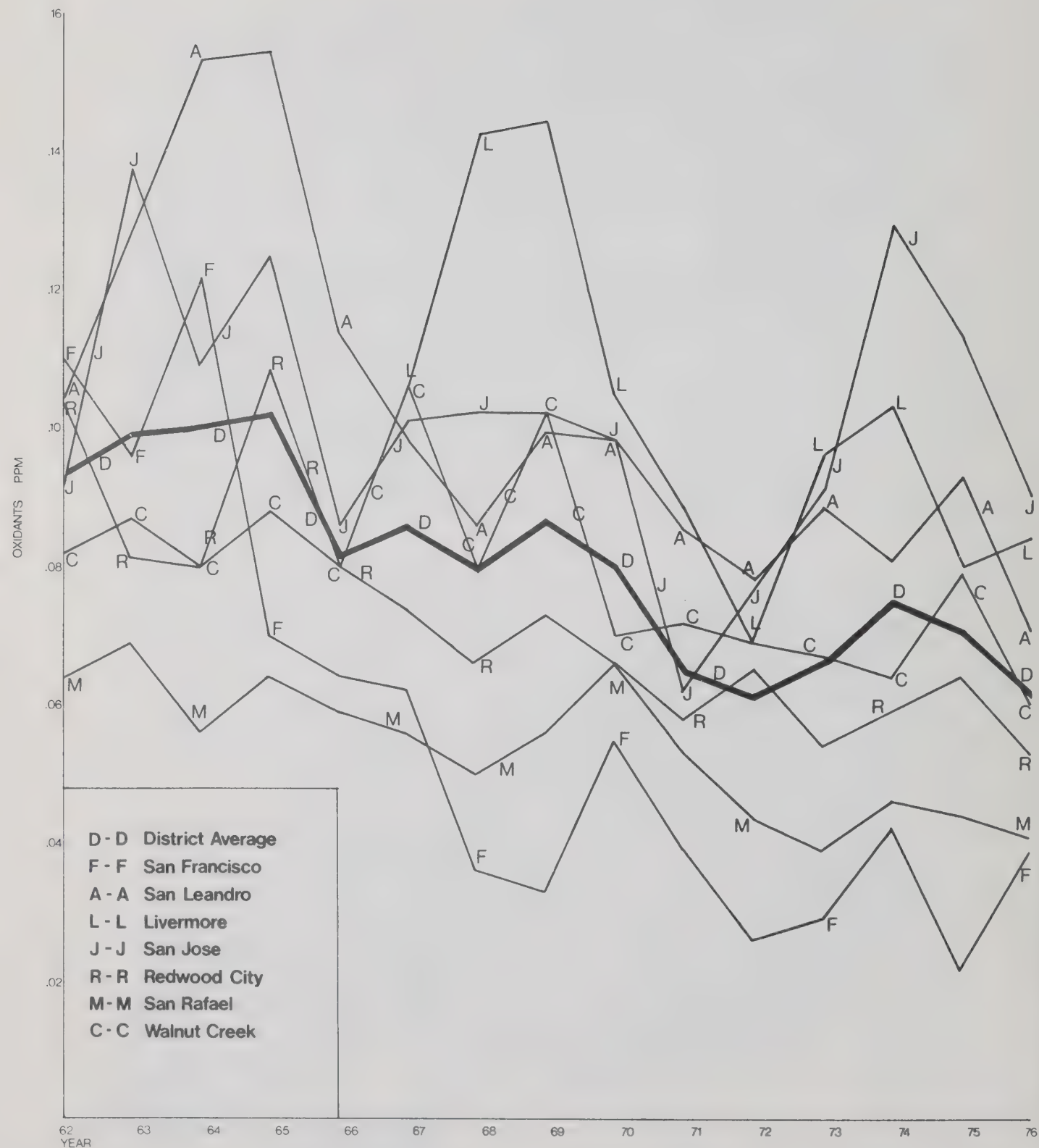
Photochemical oxidant, as the contaminant of initial and deepest concern in California has now been continuously monitored for 15 years by the BAAPCD. After peaking in 1965, the oxidant levels have shown a clear downward trend for the past 11 years, despite large annual weather-induced fluctuations. Days exceeding the Federal one-hour standard of .08 ppm averaged 131 in the 1965-69 five year period (pentad) and 85 in the 1970-74 pentad. For the 1975 base year there were 69 days over standard, and preliminary totals for 1976 show 65 days. Despite more than 50% improvement over the past decade, oxidant remains the largest and least tractable problem in terms of air quality maintenance.

For oxidant the accompanying maps plot the number of days over standard in 1975, and for comparison the average values in the 1970-74 pentad. Both maps show minimum excesses (0 to 5 days) along the coast, but in 1975 the clean band had widened and extended further inland. Maximums in both cases are over the inland sheltered valleys, but there are two significant differences. First, the 1975 intensity of the maximum is 20% lower, decreasing from 60 days to 50 days. (Preliminary 1976 data indicates a further weakening of this maximum to less than 35 days). Second, the center of the maximum has shifted from the Livermore Valley to the East Santa Clara Valley. (Preliminary 1976 data show the center remaining as in 1975, but extending more toward Gilroy than toward Livermore.)

Since the formation of oxidant is highly weather-dependent, the District has developed a "trend study" technique to damp out the primary weather factors (temperature and inversion height) and compare the oxidant levels only for days when these conditions favor its formation. Results of this study (updated to include 1976) are shown in the final graph. On oxidant-conducive days, the District average (for our 7 long-term stations) peaked at .10 ppm in 1965 and has fallen to .06 ppm in 1976. In 1971 this average fell below the Federal standard and has remained below it every since. The two long-term stations with averages remaining over standard are San Jose and Livermore.

The southeastward migration of highest values over the years is another noteworthy feature of the oxidant trend graph. San Leandro led (with over .15 ppm) in 1964 and 1965; Livermore led (with over .14 ppm) in 1968 and 1969; San Jose led (with .11 to .13 ppm) in 1974 and 1975. These highest station averages have fortunately decreased at nearly the same rate as the overall District average. The reasons for the shift appear quite complex--related to the 15-year shifts in population and vehicle use, and to the changes in emission mix and emission patterns. Additionally, the increases in emissions of primary contaminants have been into the sheltered valleys topographically and meteorologically least favorable for mixing and dispersion.

Figure 6



Trend of Average High-Hour Oxidant Concentrations For Days With Comparable Temperature & Inversion Conditions (April through October Photochemical Oxidant Seasons 1962-1976)

Air Quality Summary

The previous figures have shown graphically how air pollution is distributed throughout the region. Table 4 presents in tabular form by individual monitoring station what air quality was like in 1976. Violations of Federal or State standards are shown, as well as maximum concentration levels experienced for the year.

Table 4. AIR POLLUTION IN THE BAY AREA BY STATION AND CONTAMINANT: 1976

For oxidant and for nitrogen dioxide, "max" is the highest hourly average value expressed in parts per hundred million. For carbon monoxide, "max" is highest 8-hour average value in parts per million. (The one-hour standard for CO was never exceeded during the year.) For sulfur dioxide, "max" is highest 24-hour average value expressed in parts per million. For total suspended particulates (TSP), "mean" is annual geometric mean in micrograms per cubic meter.

Stations	OXIDANT			CO		NO ₂		SO ₂		TSP	
	Max	*	M**	Max.	*	Max.	*	Max.	+	Mean	+
San Francisco	13	2	3	11.0	4	25	1	.053	1.8	55	9.3
San Rafael	12	5	8	15.5	7	13	0	.015	0.0	36	6.4
Richmond	13	7	9	6.8	0	23	0	.013	0.0	48	12.0
Pittsburg	15	29	22	5.5	0	19	0	.015	0.0	61	16.0
Concord	17	24	—	7.4	0	23	0	.030	0.0	51	12.8
Walnut Creek	14	10	28	—	—	—	—	—	—	—	—
Oakland	15	6	7	10.5	7	—	—	—	—	—	—
San Leandro	16	9	23	—	—	—	—	—	—	—	—
Hayward	18	30	—	—	—	—	—	—	—	—	—
Fremont	16	21	39	9.8	1	28	2	.011	0.0	62	18.1
Livermore	17	29	60	7.1	0	18	0	.005	0.0	85	41.3
Alum Rock	16	31	—	—	—	—	—	—	—	—	—
San Jose	17	32	40	20.2	61	28	3	.015	0.0	71	20.8
Gilroy	21	30	—	6.8	0	23	0	.011	0.0	62	11.7
Los Gatos	14	19	32	—	—	—	—	—	—	—	—
Sunnyvale	15	22	—	12.8	14	30	4	.008	0.0	50	8.6
Mountain View	14	11	12	—	—	—	—	—	—	—	—
Redwood City	17	16	15	10.2	10	21	0	.007	0.0	59	13.0
Burlingame	15	3	10	9.5	1	22	0	.018	0.0	49	7.0
Petaluma	9	5	6	—	—	—	—	—	—	—	—
Santa Rosa	9	1	—	9.5	1	15	0	.004	0.0	66	8.6
Sonoma	13	21	—	—	—	—	—	—	—	—	—
Napa	12	16	16	10.8	2	11	0	.009	0.0	65	11.8
Vallejo	18	21	16	18.0	40	14	0	.014	0.0	52	10.2
Fairfield	14	17	16	—	—	—	—	—	—	—	—
Crockett	—	—	—	—	—	—	—	.026	0.0	—	—
Martinez	—	—	—	—	—	—	—	.020	0.0	—	—

*Number of days ambient air quality standard was exceeded. (Federal oxidant standard >8 pphm.)

M** For comparison, average number of days oxidant standard was exceeded in 1970-1974 mean.

+ Percent of observed days when State air quality standard was exceeded.

Source: Bay Area Air Pollution Control District, 1977

PRESENT AND PROJECTED EMISSIONS

This section presents a summary of present and projected emissions of five major air contaminants for the San Francisco Bay Region. The purpose of the emissions inventory is to identify each significant source of pollutants contributing to the air quality problems of the region. In some cases, it is possible to identify a single category of sources as being the major contributor to a given problem (e.g., carbon monoxide from motor vehicles or sulfur dioxide from fuel combustion in industrial and utility boilers). In other cases such as for photochemical oxidant, no single category of sources can be identified as the root of the problem. By identifying the most significant sources in each case, the emissions inventory provides direction for efforts to control emissions and minimize the problems they cause. Thus, the inventory is a crucial prerequisite to the development of any plan to improve air quality.

In order to develop a long range plan to improve air quality, it is necessary to know not only what current emission levels are, but what future emission levels will be. As described in the AQMP/Tech Memo 2 (December 1976), estimates of current emissions from each category of sources are combined with estimates of the rate of growth in each case and the expected effects of control programs which are in effect now, or adopted and scheduled for implementation. The one exception to this is the Bay Area Air Pollution Control District's New Source Review rule, which is not included in the emission projections. This is necessary so that the effectiveness of New Source Review as well as alternative New Source Review rules can be evaluated equally with other control programs. The projected emissions thus reflect normal growth trends.

Summary of the Emissions Inventory

Emission inventories have been compiled for 1975, 1985, and the year 2000, and are summarized in Tables 5, 6, and 7. They are also shown in graphic form in Figures 7 through 11. Estimates of stationary sources and aircraft emissions were made by the Bay Area Air Pollution Control District while motor vehicle emissions estimates were made through the joint efforts of the Association of Bay Area Governments, Metropolitan Transportation Commission and California Air Resources Board.

For hydrocarbons, the most significant source categories are organic compounds evaporation (otherwise known as organic solvents) and both light and heavy duty motor vehicles. Each of these source categories have previously been the target of control efforts, and it is evident that further controls will be necessary if significant air quality improvement is to be made. Total hydrocarbon emissions are projected to decrease somewhat by 1985 due to the implementation of controls now on the books, but to rise back to the 1975 level by the year 2000.

For oxides of nitrogen, the principal source categories are stationary source fuel combustion, and light and heavy duty motor vehicles. Efforts to control motor vehicle NO_x emissions have been controversial in recent years while stationary source NO_x control has been limited to only the largest sources. The problem in pursuing NO_x control is

that NO_x alone is not a problem in the Bay Area. It is a contributor to the photochemical oxidant problem in the region, but its precise role has not been well defined to date. NO_x emissions are projected to remain at a relatively constant level over the 25 year planning time frame. By 1985, the expected increase in stationary source NO_x emissions due to increased use of fuel oil will be offset by additional motor vehicle NO_x control. By 2000, increasing usage of nuclear fuels for electric power has been assumed to offset increased NO_x emissions in other source categories.

In the case of carbon monoxide, light and heavy duty motor vehicles are by far the most significant sources. Unlike hydrocarbon and NO_x emissions, CO emissions are projected to be substantially greater in the year 2000 than they are in 1975. The principal causes are the overall growth in vehicle activity over the 25 year period, and the expected deterioration of current vehicle emission control devices.

Sulfur dioxide emissions are due primarily to stationary source fuel combustion, and petroleum refining and chemical operations. A substantial increase in SO₂ emissions is projected to occur by 1985, due primarily to the progressively limited supplies of natural gas and the expected switch to fuel oil and coal for combustion processes. SO₂ emissions decrease slightly by the year 2000 due to an assumed switch of a portion of PG&E's electric power generating capacity to nuclear plants.

Finally, emissions of suspended particulate matter are produced from many diverse sources, with no single source or sources contributing a large share. Emissions for this pollutant are projected to increase steadily between 1975 and 2000. A significant unknown is the contributions to particulates from windblown dust and secondary organics (photochemical aerosol). Until these unknowns are better defined, it will be difficult to properly interpret the emission inventory for particulates.

Figures 12-14 provide a more detailed breakdown of certain large emission categories. Figure 12 divides motor vehicle emissions into the major vehicle categories. Figure 13 and 14 detail the organic solvent and combustion emissions by source type for 1985.

TABLE 5. 1975 EMISSIONS BY MAJOR SOURCE CATEGORY

MAJOR SOURCE CATEGORY	EMISSIONS (TONS/DAY)				
	HC	NO _x	CO	SO ₂	Part.
Petroleum Refining	25.2	5.9	-	39.0	2.5
Chemical	5.5	3.1	37.3	84.6	4.9
Other Industrial/Commercial	10.2	2.5	21.7	5.9	75.3
Petroleum Refinery Evaporation	46.0	-	-	-	-
Gasoline Distribution	60.4	-	-	-	-
Other Organic Compounds Evaporation (Organic Solvents)	311.1	-	-	-	-
Combustion of Fuels	8.1	196.0	17.5	43.7	16.3
Burning of Materials	19.8	1.4	58.2	0.3	12.9
Off-Highway Mobile Sources	45.0	59.4	277.7	25.8	5.2
Aircraft	19.6	13.5	54.5	1.3	9.0
Light-duty Automobiles	340.1	231.7	2,357.0	7.4	27.8
Other Motor Vehicles	<u>132.2</u>	<u>167.8</u>	<u>1,507.0</u>	<u>11.3</u>	<u>15.2</u>
TOTAL (TONS/DAY)	1,023	731	4,331	219	169

TABLE 6. 1985 EMISSIONS BY MAJOR SOURCE CATEGORY

MAJOR SOURCE CATEGORY	EMISSIONS (TONS/DAY)				
	HC	NO _x	CO	SO ₂	Part.
Petroleum Refining	41.0	15.2	-	67.5	4.4
Chemical	5.6	2.9	37.5	89.1	5.2
Other Industrial/Commercial	11.1	2.7	24.0	6.5	80.8
Petroleum Refinery Evaporation	50.0	-	-	-	-
Gasoline Distribution	27.1	-	-	-	-
Other Organic Compounds Evaporation (Organic Solvents)	344.8	-	-	-	-
Combustion of Fuels	11.5	321.1	21.3	213.9	34.5
Burning of Materials	22.2	1.5	62.7	0.3	13.9
Off-Highway Mobile Sources	50.3	73.7	322.6	30.9	6.3
Aircraft	20.2	19.6	69.9	1.6	11.4
Light-duty Automobiles	117	89.3	1,768.7	9.7	18.8
Other Motor Vehicles	96	165.8	1,699.3	15.0	16.3
TOTAL (TONS/DAY)	797	692	4,006	435	192

TABLE 7. 2000 EMISSIONS BY MAJOR SOURCE CATEGORY

MAJOR SOURCE CATEGORY	EMISSIONS (TONS/DAY)				
	HC	NO _x	CO	SO ₂	Part.
Petroleum Refining	55.4	20.0	-	88.9	5.8
Chemical	6.	3.9	37.5	119.8	6.1
Other Industrial/Commercial	12.7	3.1	24.0	7.4	90.5
Petroleum Refinery Evaporation	52.1	-	-	-	-
Gasoline Distribution	28.2	-	-	-	-
Other Organic Compounds Evaporation (Organic Solvents)	493.4	-	-	-	-
Combustion of Fuels	15.0	279.8	25.7	129.9	30.7
Burning of Materials	23.6	1.7	69.7	0.4	22.5
Off-Highway Mobile Sources	75.4	94.1	389.3	31.1	7.8
Aircraft	27.8	32.7	106.3	2.5	19.4
Light-duty Automobiles	160.6	77.1	2,505.0	13.2	22.3
Other Motor Vehicles	<u>107.1</u>	<u>208.4</u>	<u>2,505.0</u>	<u>20.4</u>	<u>19.8</u>
TOTAL (TONS/DAY)	1,058	721	5,663	414	225

Figure-7

HYDROCARBON EMISSION TRENDS

SAN FRANCISCO BAY REGION

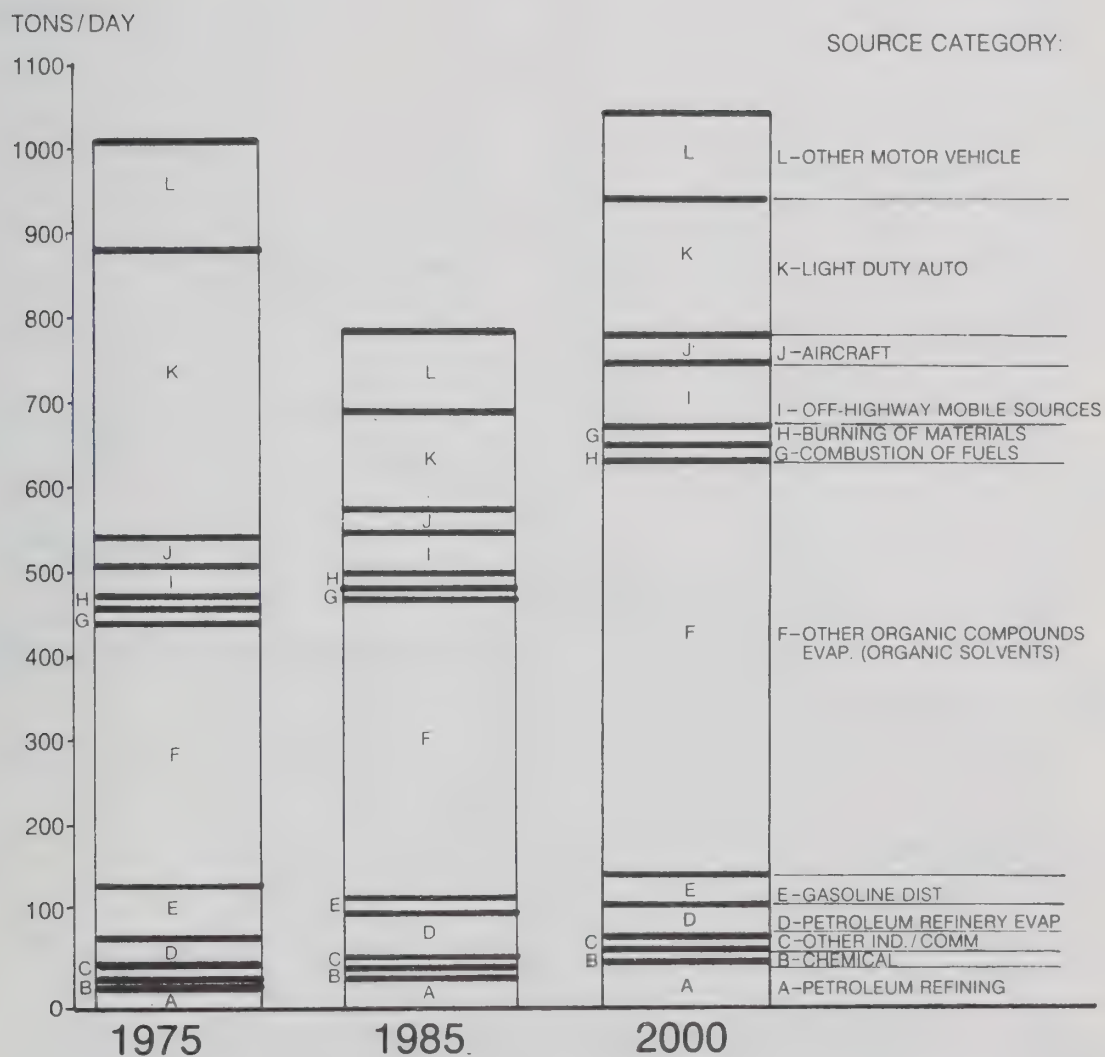


Figure- 8

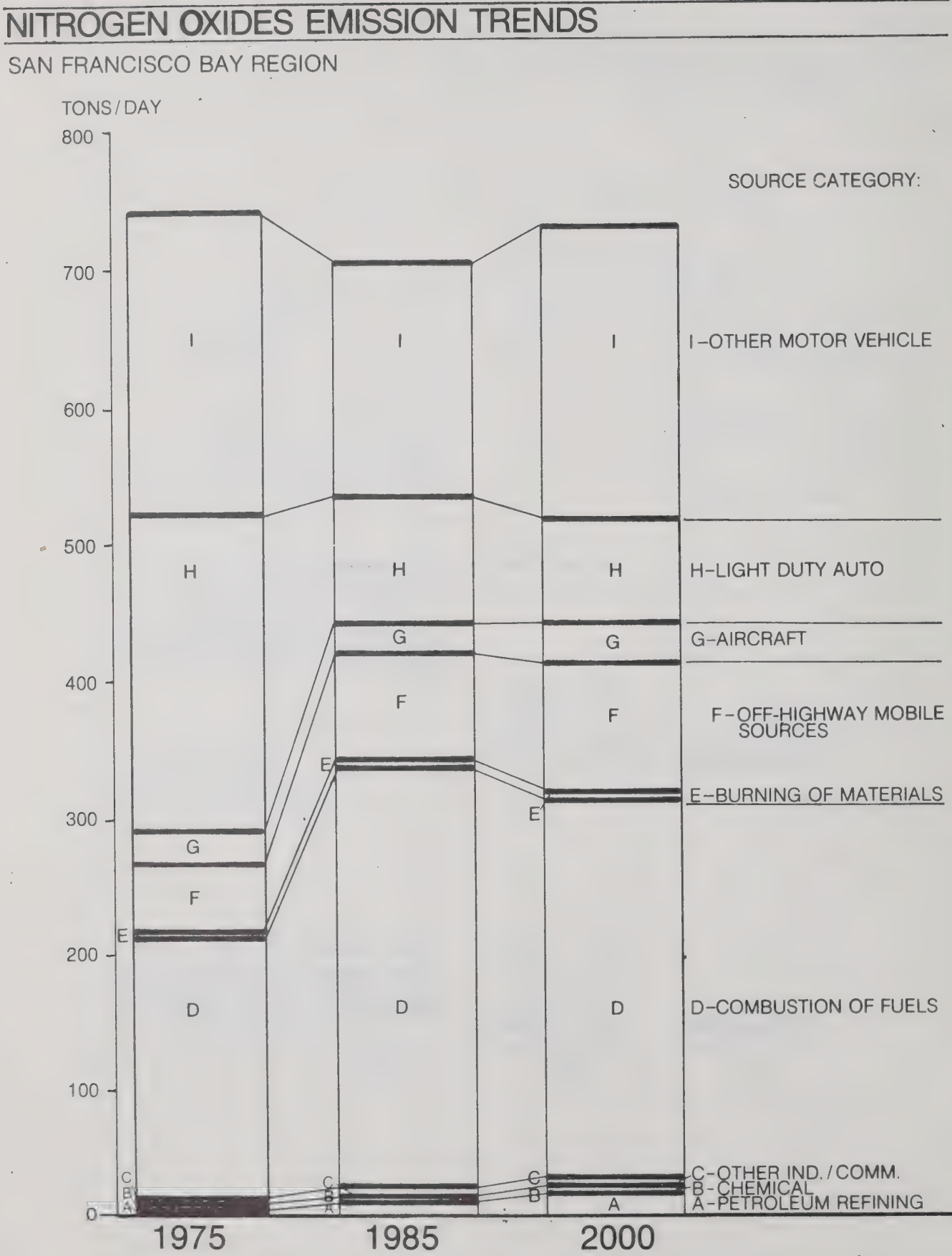


Figure-9

CARBON MONOXIDE (CO) EMISSION TRENDS

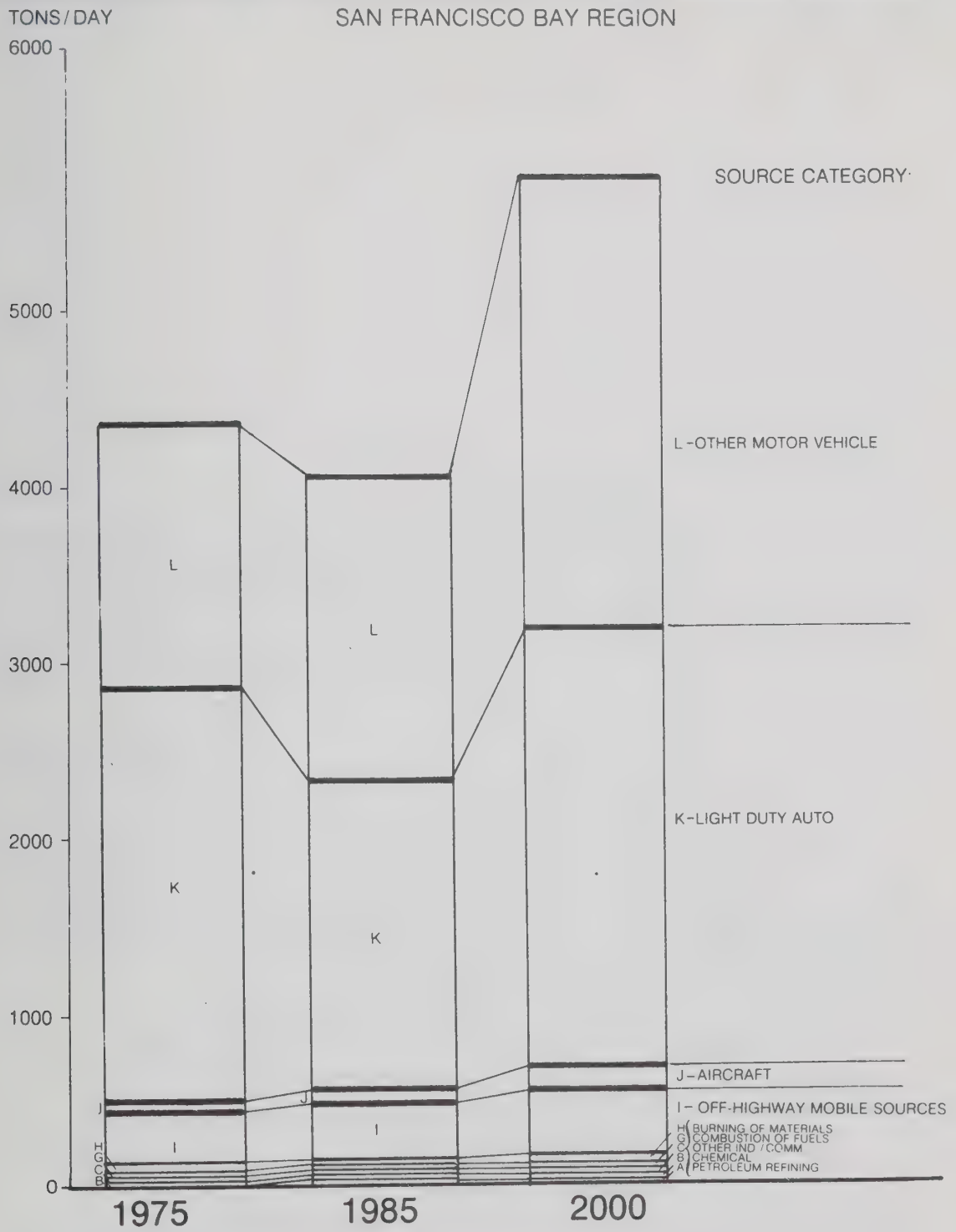


Figure - 10

SULFUR DIOXIDE EMISSION TRENDS

SAN FRANCISCO BAY REGION

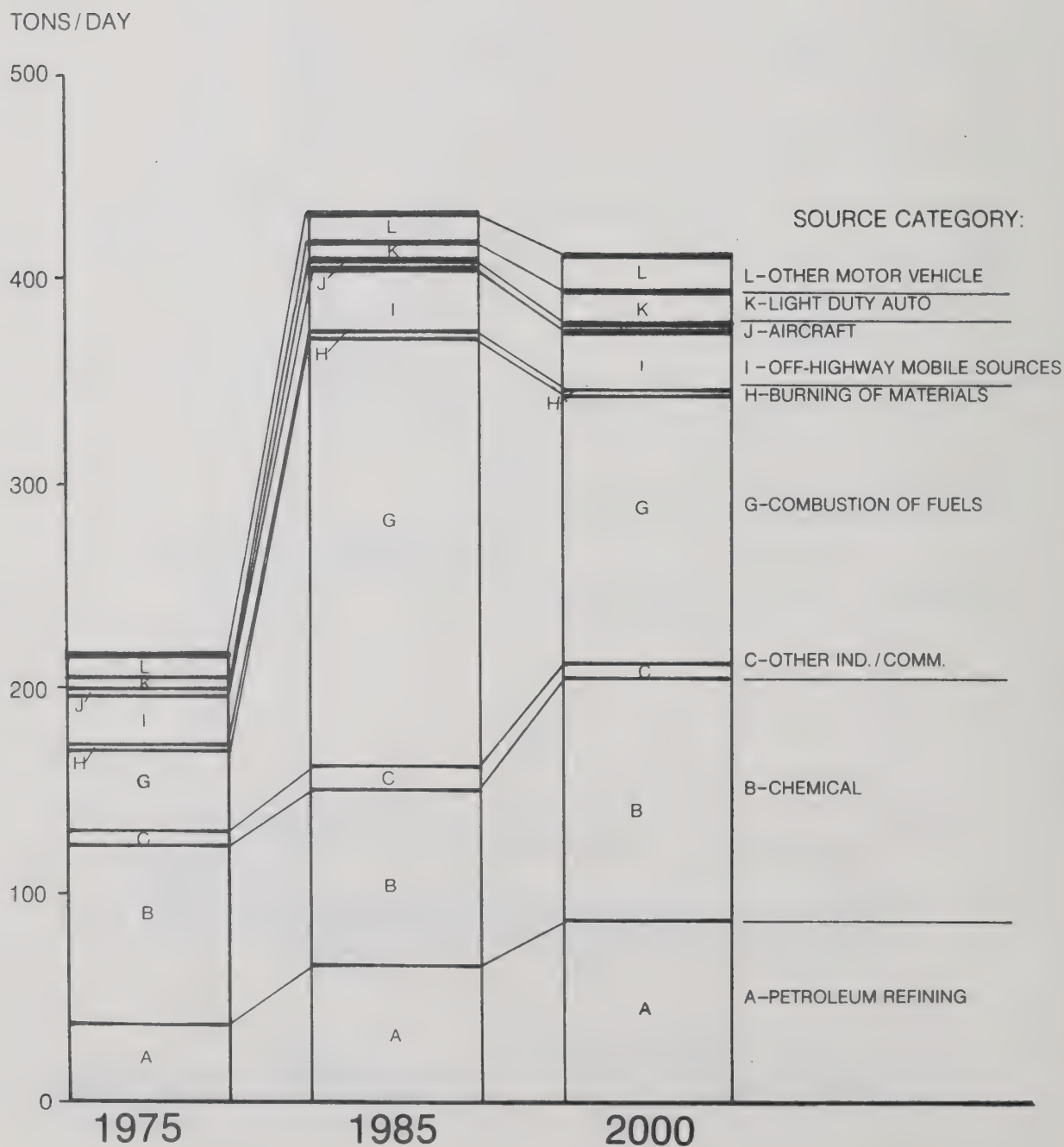


Figure - 11

PARTICULATES EMISSION TRENDS

SAN FRANCISCO BAY REGION

TONS/DAY

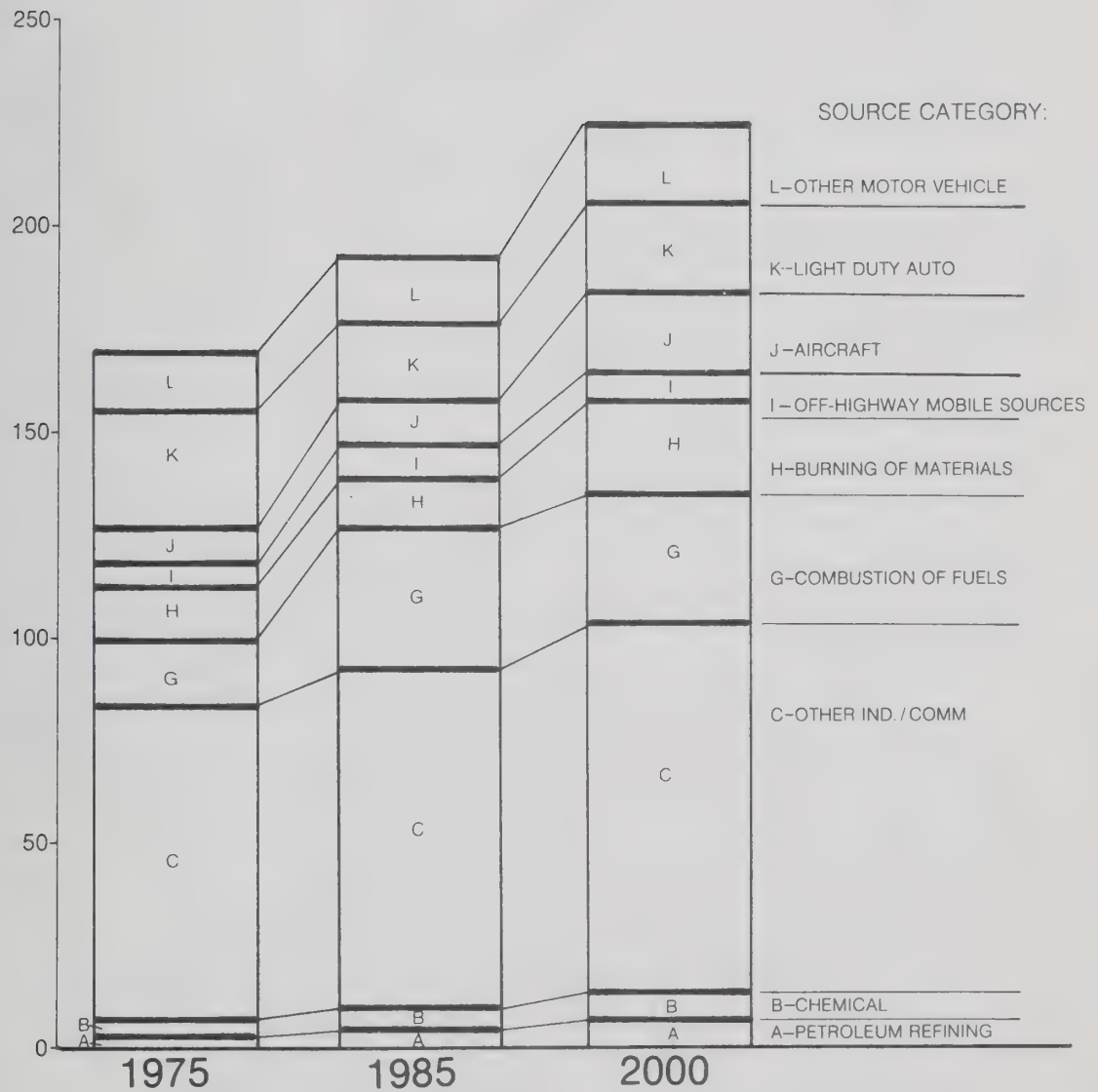


Figure-12

MOTOR VEHICLE EMISSIONS (1985)

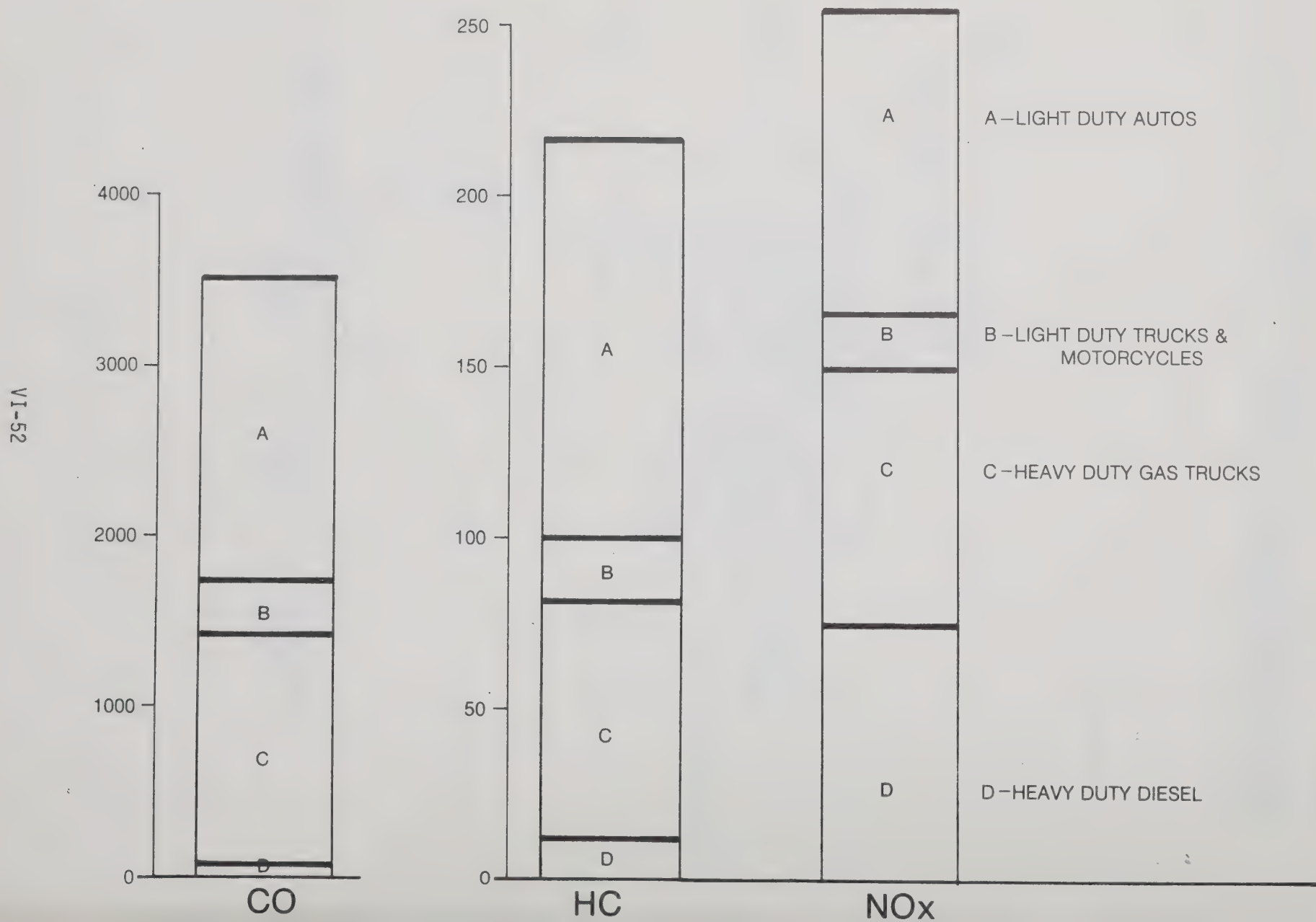


Figure-13

BREAKDOWN OF ORGANIC SOLVENT EMISSIONS BY SOURCE TYPE IN 1985

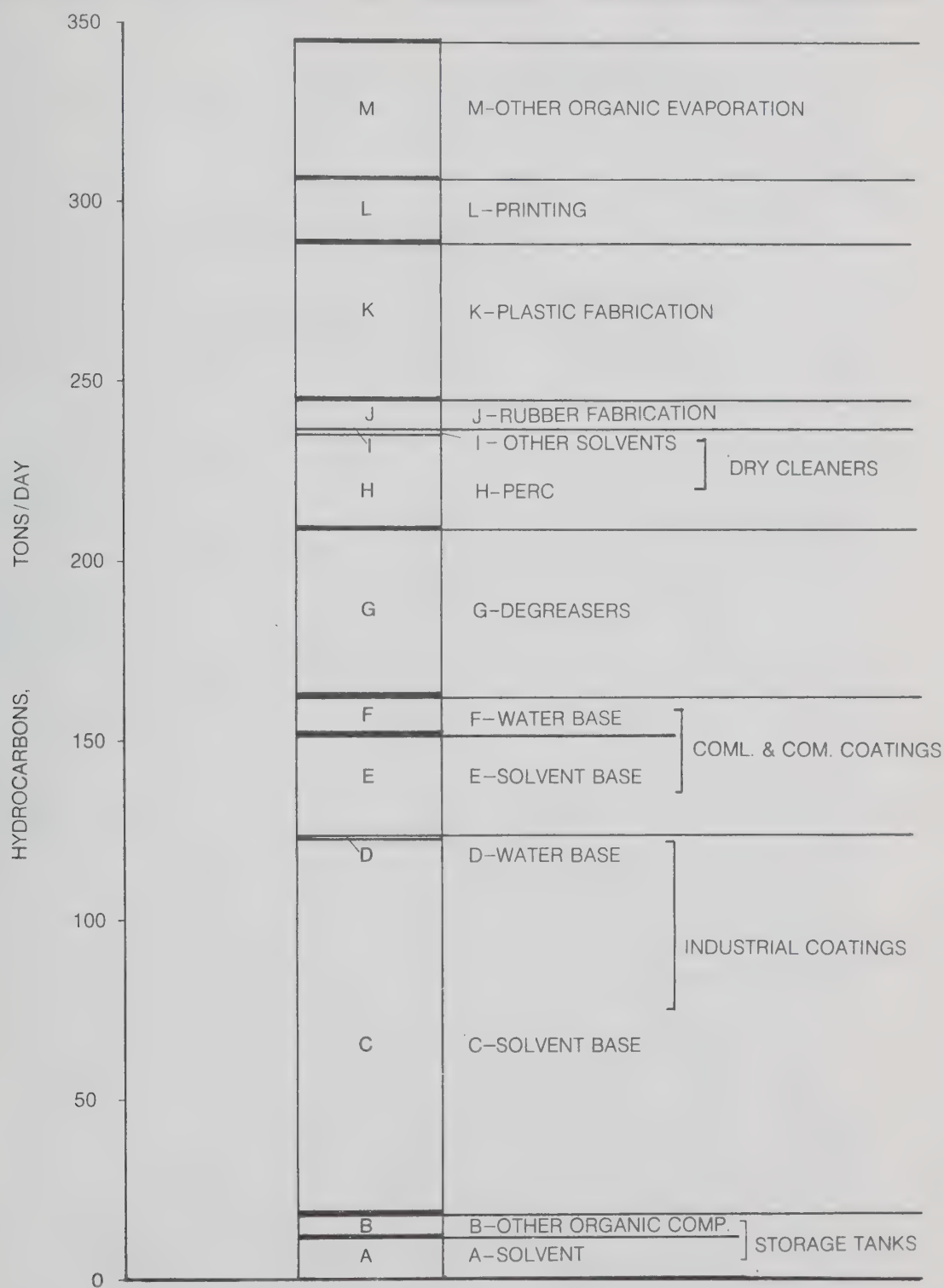
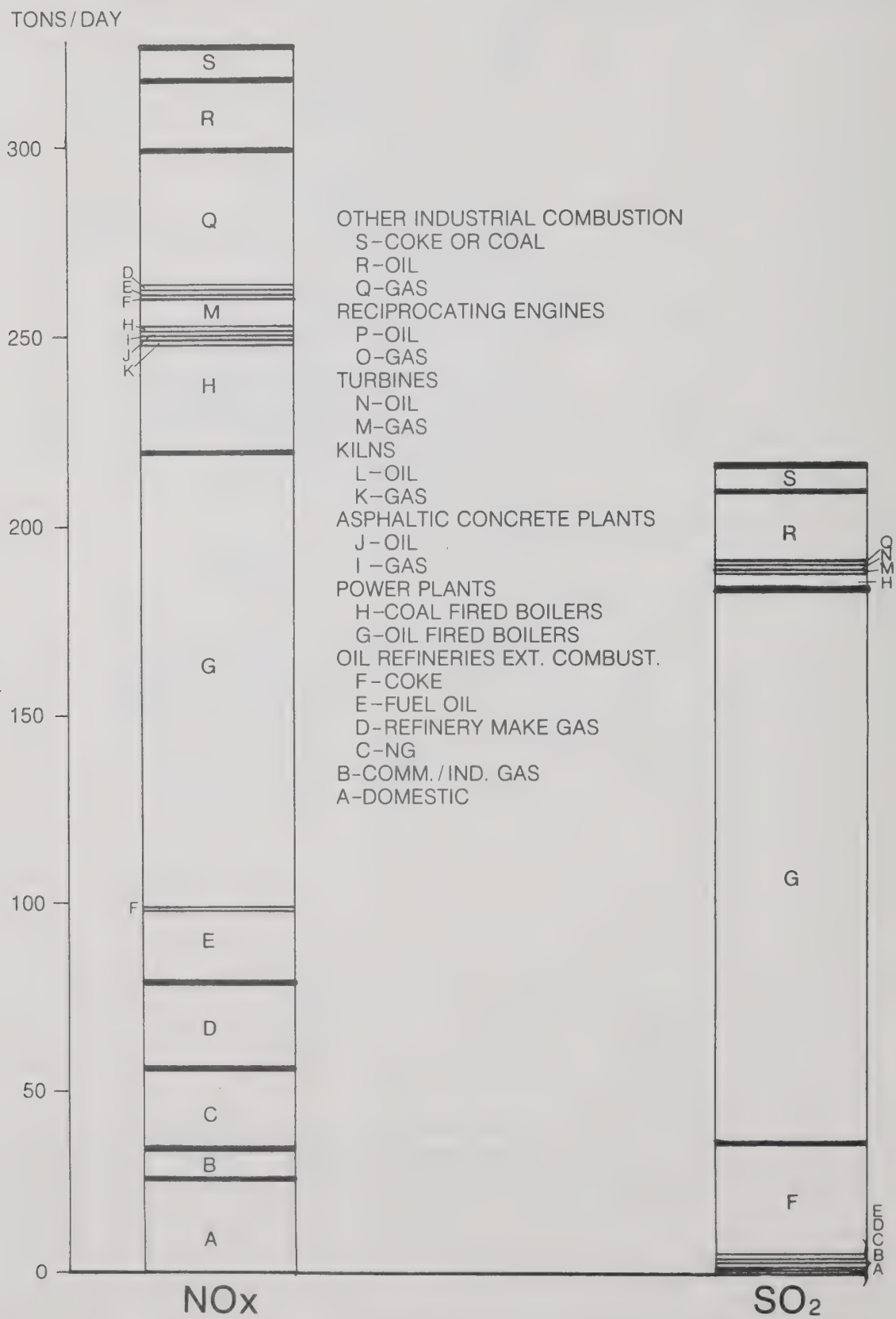


Figure - 14

BREAKDOWN OF FUEL COMBUSTION EMISSIONS BY
SOURCE TYPE IN 1985



AIR QUALITY TRENDS

Based on historical air monitoring data, the emission inventory projections, and air quality models, it is possible to forecast air quality trends. These trends project future air quality assuming no additional controls beyond those in place or scheduled.

- Sulfur dioxide - Sulfur dioxide emissions are projected to double by 1985, due primarily to the expected switch from natural gas to fuel oil and coal in electric utility and industrial boilers. Consequently, it is expected that SO₂ levels will increase substantially. The increased emissions are not projected to result in violations of the Federal standards. Recently, California revised its standards for SO₂. This revision complicates the assessment of the impact of emission increases on compliance with the SO₂ standard because it is now dependent on oxidant and particulate levels. Neither historical data bases nor available modeling techniques are ready to address the new standard at this time. A more detailed assessment of the State SO₂ problems projected is recommended for the continuing planning process.
- Total suspended particulates - Emissions of particulate matter are projected to increase steadily from 1975 to 2000. As previously described, both Federal and State standards for particulates are violated in the region by a small margin. The significance of the increased emissions with respect to future violations cannot be assessed with existing data. The two largest components of particulate matter in the Bay Area's atmosphere are organic matter and dust. The development of a control strategy must await the collection of more refined data to identify the nature and sources of particulates in the air. The research work to obtain this data is recommended for the continuing planning process.
- Carbon monoxide - By far the dominant source of carbon monoxide emissions is motor vehicles. By 1985, a modest improvement of about ten percent will occur due to State and Federal motor vehicle control programs. By 2000, however, a substantial increase in CO levels beyond those experienced in 1975 will occur. The number of vehicles and the number of miles driven in the region are projected to increase by about 70 percent between 1975 and 2000. It appears the emission control technologies currently used for automobiles and trucks may not be sufficient to prevent continuing violations of the CO standard in the Bay Area. When this AQMP program was initiated, the established CO emission factor was 9.0 grams/mile for light duty vehicles. The projections shown in Figure 9 have assumed this factor. More recently, the 1977 Clean Air Act and discussions with the CARB reveal that a more stringent emission factor will ultimately be adopted. As these changes are finalized, the inventory will have to be updated to reflect the changes. CO problems are localized and occur in relatively few areas of the region. Solutions to these problems require a case by case analysis of the causes of the problems. The current AQMP effort has not conducted any detailed CO studies at a local level. These are recommended as part of the continuing planning process.

- Nitrogen dioxide - The Federal standard for nitrogen dioxide is not currently violated. In addition, the emission inventory projection for NO_x does not indicate a significant increase in NO_x emissions. The conclusion is therefore that no future violations of the nitrogen dioxide Federal standard are expected. California has a 0.25 ppm-one hour average NO₂ standard. In 1976, this standard was violated several times in a few Bay Area locations. These violations are suspected to be mobile source related. If this is the case, the current CARB controls for NO_x emissions from motor vehicles may solve the NO₂ problem. The analysis of oxidant control strategies shows additional controls of NO_x emissions beyond those currently planned for will worsen the oxidant air quality in the Bay Area. Because of the counterproductive aspects of such controls, no additional NO_x controls are proposed in this plan. A summary of the critical issues facing the region about whether or not more NO_x controls are needed is presented in Section 6. Technically, this is the most controversial issue facing the Bay region.
- Photochemical Oxidants - Oxidants (primarily ozone) are formed in the atmosphere from emissions of hydrocarbons and oxides of nitrogen. From the emission inventory projections, hydrocarbon emissions are expected to decline moderately by 1985, and to rise back to the 1975 level by the year 2000. Oxides of nitrogen are projected to remain relatively constant from 1975 to 2000. These projections suggest that oxidant levels will be moderately reduced (an approximate 10 to 20 percent improvement) by 1985, but this improvement will not be maintained through the year 2000. Air quality data collected over the past several years indicate a slow trend toward lower oxidant levels and it is expected that this trend will continue for several more years. Somewhere around 1985, the trend will reverse if no further controls are implemented. Since oxidants are generally considered to be the most serious regional air quality problem, it has been analyzed extensively in this program. Most of the remaining report deals with the oxidant problem and recommended strategies for solving it.

THE LIVERMORE REGIONAL AIR QUALITY MODEL (LIRAQ)

Complex atmospheric and chemical relationships combine to determine air quality on an urban and regional basis. The use of sophisticated planning and analysis tools is necessary for developing information to guide in making decisions that will affect this air quality. The set of computer codes, which together comprise the Livermore Regional Air Quality (LIRAQ) model, have been developed as an operational tool to assist air quality planners and control agencies in tasks such as assessing the compliance of present air quality with Federal ambient air quality standards, evaluating the impact on regional air quality of various land use alternatives, and predicting the effect on regional air quality of new sources and various control strategies.

The LIRAQ model has been developed by the Lawrence Livermore Lab (LLL) with the support of the National Science Foundation (NSF) and in cooperation with the Bay Area Air Pollution Control District (BAAPCD). The BAAPCD has provided a detailed source inventory and much of the information needed to compare the numerical model predictions with observations. It is also the initial user agency. Also involved were the NASA Ames Research Center, which used its instrumented aircraft to gather data for model comparison with observation.

The LIRAQ model attempts to treat most of the important factors that determine regional air quality as a function of time. The region of initial interest, the San Francisco Bay Area, is characterized by both its complex topography and its changing meteorology. As shown in Figure 16, the region has quite intricate geographic features, including numerous ridges, hills, valleys, the Pacific Ocean, a central bay, and major inland flats. Meteorological systems formed over the Pacific Ocean are influenced by the complex Bay Area topography to create complicated, temporally and spatially varying wind fields, and inversion base heights. The model treats both the complex topography and changing meteorology on one of several available grid scales (1 km or greater) from which the user may choose to study a particular air quality problem. The model does not attempt to forecast tomorrow's air quality, because that would require the capability to forecast the regional meteorology, a formidable problem in itself. Instead, in LIRAQ, the meteorology must be specified, either at measurement stations or by coordinates. Typically, this involves use of either real or hypothetical meteorological situations (based on sets of previously acquired meteorological observations) that may be expected to be similar to future weather patterns.

The air quality region capable of being studied is based on the boundaries of the BAAPCD and encompasses all or parts of nine counties.

Within the approximate 14,000 km² of the BAAPCD, the emission of pollutants is spread in a non-uniform pattern over the region of interest. The model deals with four separate types of pollutant sources:

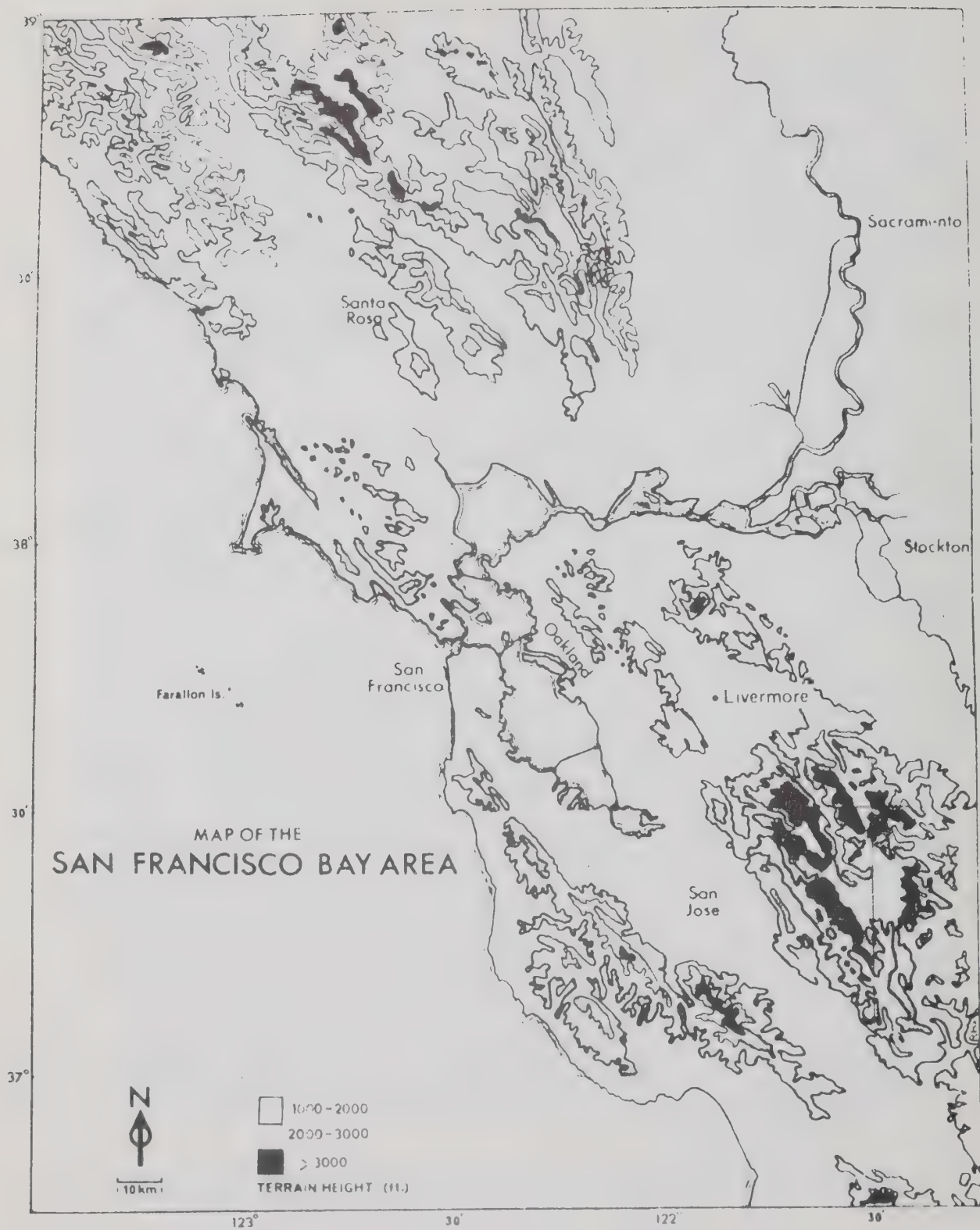


Figure 15. Topography of the San Francisco Bay Area

- Mobile (using emissions derived from a traffic model that represents the Bay Area traffic network using about 13,600 highway links and simulates hourly loading--compiled by ABAG, MTC, and the CARB).
- Point (based on a compilation of major point sources from the BAAPCD with an hourly emission cycle and differentiating between surface and elevated).
- Airport (treated as limited-area surface sources with estimated hourly air traffic loading).
- Area (based on a distribution of estimated emissions using data from ABAG's Series 3 projections).

The pollutant species of interest in studying the regional air quality in the Bay Area can be divided into primary and secondary species. The primary species (meaning those which have identifiable man-made sources) that the LIRAQ model can treat are carbon monoxide (CO), nitric oxide (NO), and hydrocarbons (HC). Based on the particular reaction set used in this model to treat photochemical air quality, hydrocarbons are divided into three characteristic types based on their reactivity: HC1 (mainly alkenes), HC2 (mainly alkanes, simple aromatics, ethers, alcohols, etc.), and HC4 (mainly aldehydes, some ketones, some aromatics). In addition, secondary species (those created through chemical transformation processes in the atmosphere) including ozone (O₃), nitrogen dioxide, (NO₂), and others must be and are treated by the LIRAQ model.

The LIRAQ model is capable of simulating the time- and space-varying concentrations of non-reactive and reactive pollutants on a regional basis using prescribed meteorology and source emissions. The basic types of questions that the model has been designed to deal with can be derived into three categories:

- Assessment of present air quality: By inputting to the model the present regional pattern of source emissions, the air quality on specific days can be simulated. While observations from monitoring stations do provide an indication of present air quality at a few points (observations with which the model results may be compared), the model also indicates what the air quality is at locations between such observation sites. Such results may thus point to regions where more extreme air pollutant concentrations may prevail than are being measured. Such information may then assist in locating monitoring stations or indicate where mobile measurement stations should sample.
- Development of emission control strategies: For regions which do not meet the Federal air quality standards, the development of control strategies is an important consideration. A variety of model simulations may prove useful, depending on the time and spatial scale of the problem. One application might be to

determine the relative role played by various types of sources--mobile, point, airport, and area--in degrading regional air quality. Another subject to investigate might be the relative importance of various species, as for example the importance of hydrocarbons with different reactivities. With such information, control strategies could be proposed and their effect simulated in order to determine the sense and magnitude of the effect.

- Planning for future air quality: Although control of emissions is the primary way to improve present air quality, proper planning of the locations, extent, and mix of future pollutant emissions is believed to be useful in assuring that future air quality meets appropriate standards. More specifically, the effect on air quality of a proposed source of subregional significance can be evaluated. In addition to investigating land use, planning for potential changes in fuel usage can be undertaken. For example, the potential effect of substituting fuel oil for natural gas could be simulated, assuming emission data can be specified.

The range of problems that are being addressed by air quality planners is very broad. The current AQMP effort has addressed many of the issues regarding oxidant control strategies. Many more issues still remain to be investigated. The following section and chapters describe much of the technical support analysis leading to recommendations for a comprehensive control strategy to solve the region's oxidant problem.

BASELINE PHOTOCHEMICAL OXIDANT TRENDS

Using prototype meteorological data and the emissions inventory projections previously described, photochemical oxidant forecasts were made for the Bay Area for 1985 and 2000. These results are presented in Tables 8 and 9. These projections show that regional oxidant is expected to improve between 1975 and 1985 by approximately 20%. This improvement is anticipated largely because of the Federal and California motor vehicle control programs. Between 1985 and 2000, however, due to growth in population, motor vehicles, and normal urban activities (e.g., painting, printing, dry cleaning), the oxidant is projected to deteriorate to about 1975 levels again. Figures 16-18 show LIRAQ projection results for 1975, 1985, and 2000 in the southern parts of the region.

LIRAQ is somewhat limited in the areas it can simulate during any one run. Table 8 presents results of the southern Bay areas while Table 9 presents data for the north Bay counties. The north Bay results should be viewed with caution since the prototype meteorology assumed for the analysis is not indicative of adverse meteorological conditions which have been experienced in the north Bay. The north Bay results do show, however, the trends generally predicted for the entire Bay region. Between 1975 and 1985, most north Bay areas will experience modest improvements in oxidant. This improvement will reverse itself around 1985, until oxidant levels in 2000 deteriorate back to 1975 levels.

Table 8. Bay Area Baseline LIRAQ Projections (1975-2000)

	1975	1985	2000
Location of Regionwide High Hour Ozone	9.5 Kms SSE of Livermore	9.5 Kms SSE of Livermore	9.5 Kms SSE of Livermore
Regional High Hour (ppm)	.17	.13	.17
Monitoring Station with Highest Ozone	Livermore	Livermore	Livermore
Ozone at Highest Station (ppm)	.13	.10	.13
Projected Ozone Maximum at Individual Stations (ppm)			
San Francisco	.02	.02	.02
San Rafael	.02	.02	.05
Pittsburg	.04	.03	.05
Livermore	.13	.10	.12
Fremont	.07	.05	.06
San Jose	.13	.09	.13
Redwood City	.09	.06	.07
Concord	.06	.05	.06
Richmond	.04	.03	.04
Half Moon Bay	.03	.03	.03
San Leandro	.07	.05	.06
Los Gatos	.07	.05	.07
Vallejo	.05	.04	.04

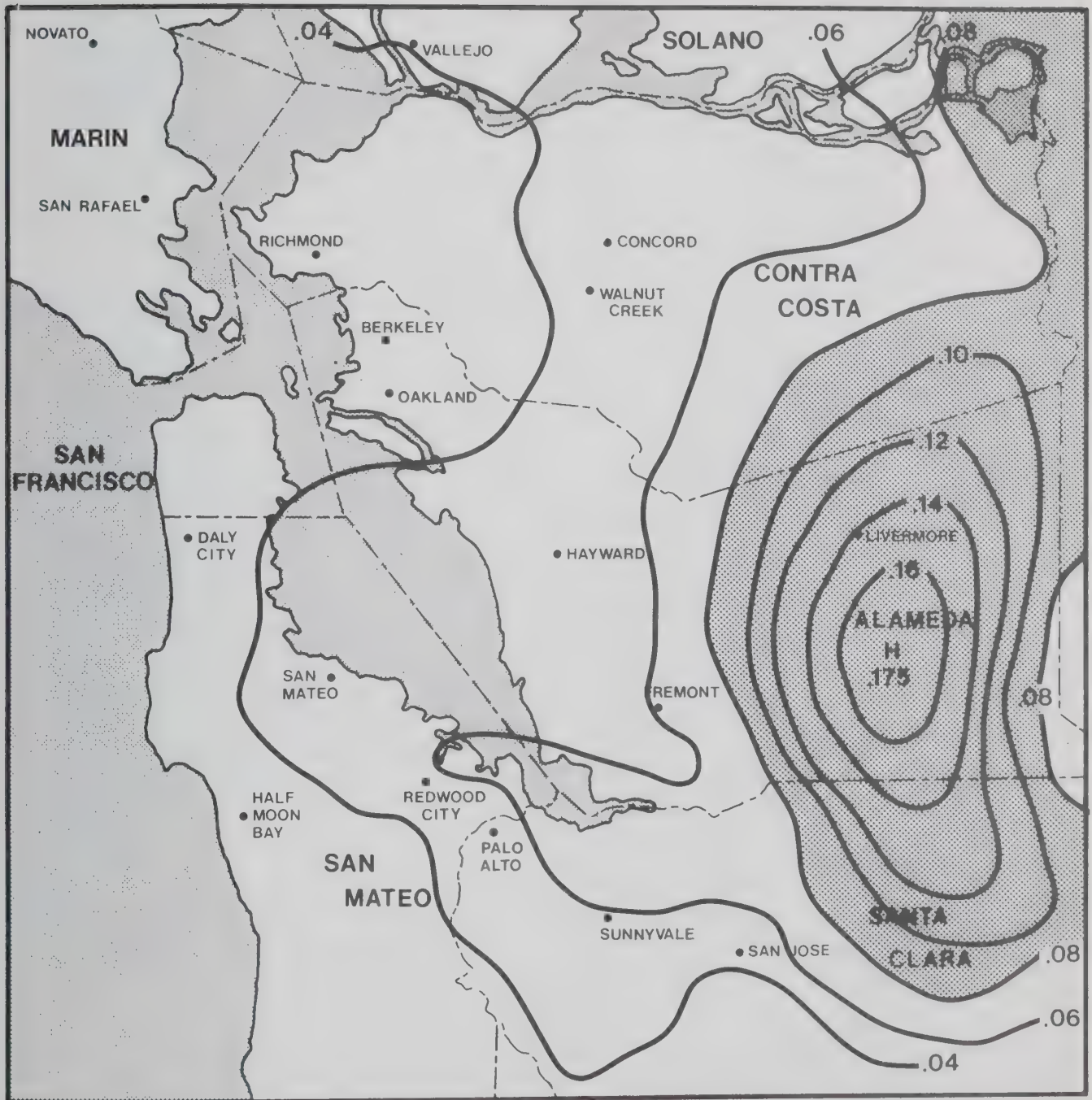
- NOTES: 1) Prototype day assumed is July 26, 1973. On this day the maximum oxidant level recorded was 0.18 ppm monitored in Livermore.
- 2) The Federal photochemical oxidant standard is 0.08 ppm - one hour, not to be exceeded more than once per year.
- 3) Projections presented are uncorrected for worst case conditions.

Table 9. Bay Area Baseline LIRAQ Projections
(North Bay) 1975-2000

	1975	1985	2000
Location of North Regional High Hour Zone	Napa Airport	12 Km. ESE Travis AFB	12 Km. ESE Travis AFB
North Regional High Hour (ppm)	.08	.07	.08
Monitoring Station with Highest Ozone	Napa Airport	Travis AFB	Napa Airport
Ozone at Highest Station (ppm)	.08	.06	.07
Projected Ozone Maximum at Individual Stations (ppm)			
San Francisco	.02	.02	.02
Santa Rosa	.04	.04	.04
San Rafael	.03	.03	.03
Petaluma	.04	.04	.04
Napa	.08	.06	.07
Sonoma County Airport	.03	.03	.07
Pittsburg	.06	.04	.05
Hamilton Air Force Base	.03	.03	.03
Napa County Airport	.08	.06	.07
Concord	.07	.05	.06
Richmond	.04	.03	.04
Travis Air Force Base	.07	.06	.07
Angel Island	.04	.03	.04
Point Bonita	.04	.03	.04
Fairfield	.06	.06	.06

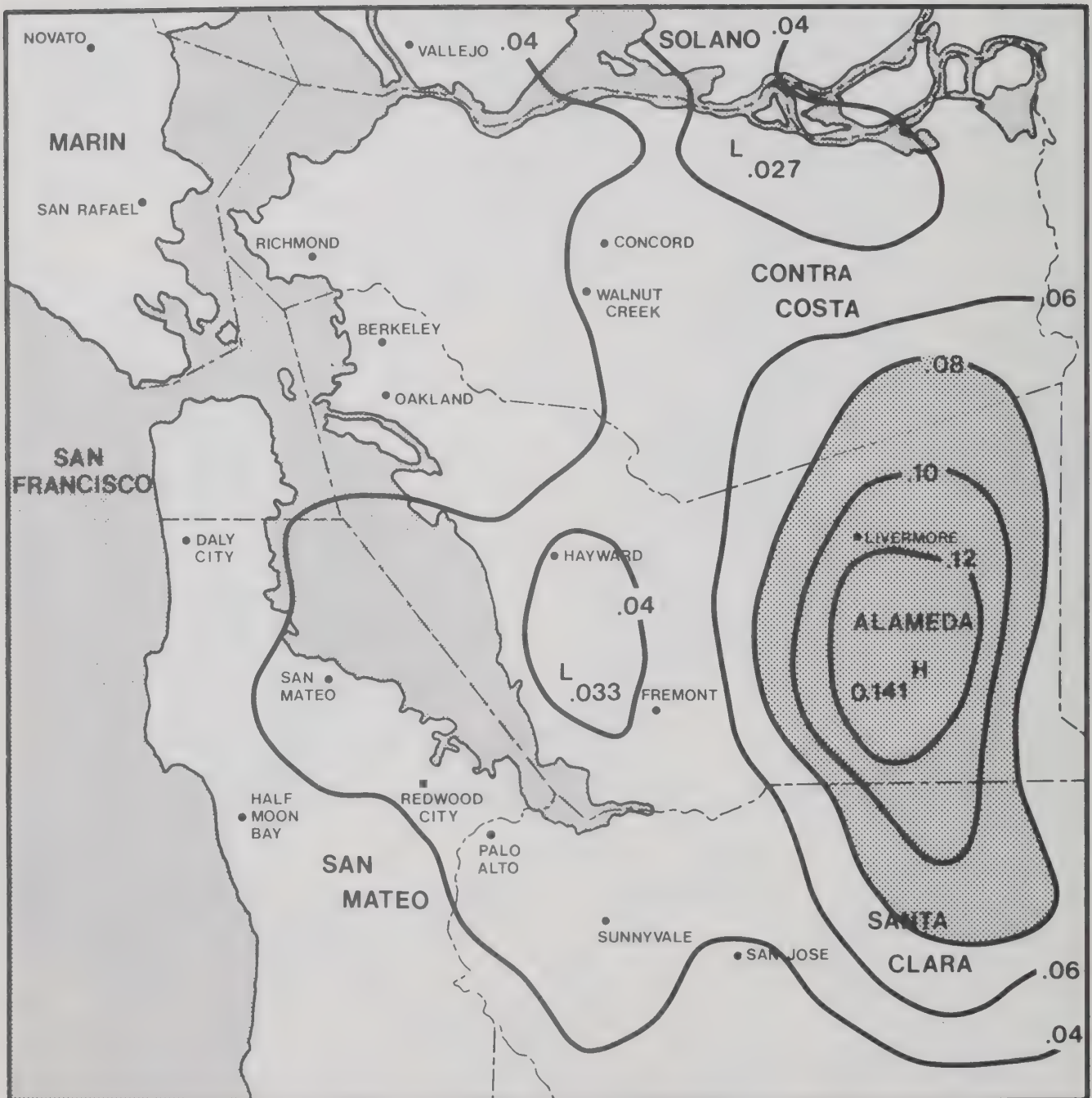
- NOTES: 1) Prototype day assumed is July 26, 1973. On this day the maximum oxidant level recorded was 0.18 ppm monitored in Livermore.
2) The Federal photochemical oxidant standard is 0.08 ppm - one hour, not to be exceeded more than once per year.
3) Projections presented are uncorrected for worst case conditions.

Figure 16. Example LIRAQ Results - 1975 Baseline Ozone Projections



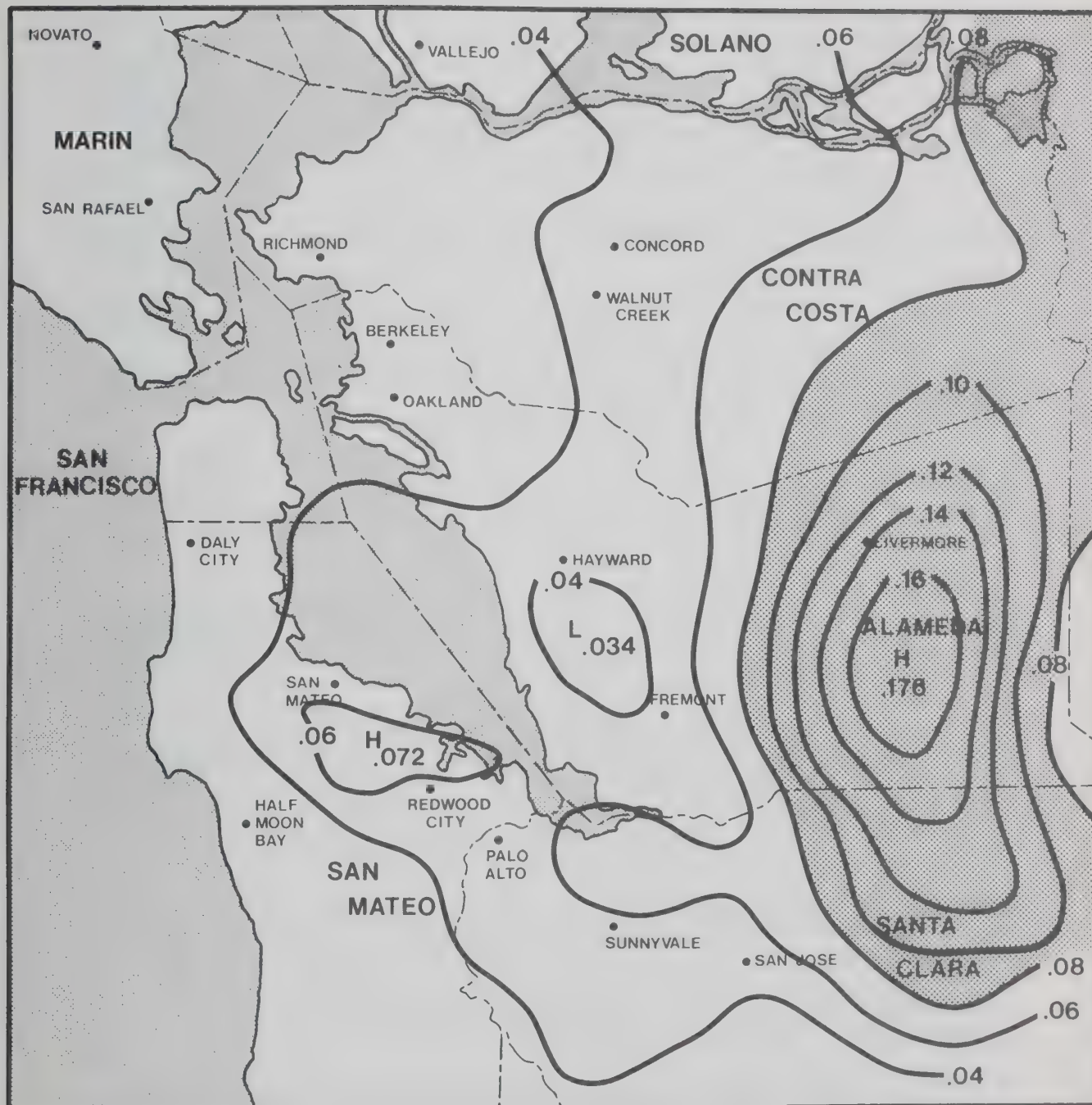
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Federal oxidant standard is 0.08ppm - 1 hour

Figure 17. Example LIRAQ Results - 1985 Baseline Ozone Projections



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Federal oxidant standard is 0.08ppm - 1 hour

Figure 18. Example LIRAQ Results - 2000 Baseline Ozone Projections



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Federal oxidant standard is 0.08ppm - 1 hour

Major Assumptions Used in the Baseline Oxidant Trends

Any projections of future conditions requires that certain assumptions be made. For air quality projections, many assumptions are made regarding future conditions. As subsequent AQMP updates are prepared, these assumptions need to be reviewed. New information and/or circumstances should be incorporated to AQMP updates so that the control strategies being applied can be examined for their overall effectiveness. As appropriate, new programs may need to be implemented. Conversely, control programs in effect can be reexamined to see if they are still needed. This section describes the major planning assumptions that were used to produce the baseline oxidant projections.

Population, Housing, Employment, and Land Uses. The "Provisional Series 3 Projections" (March, 1977) were generally used as the basis for demographic data needed. In particular, the upper range (commonly referred to as Base Case 1) of population was used. In 2000, it was assumed the region would grow to approximately 6.1 million people. (In the strategies analyzed for air quality improvement, the lower population assumption of 5.4 million people in 2000 was also analyzed for its air quality implications.)

Emission Inventory Projections. Emissions projections for stationary source and aircraft have been made by the BAAPCD, and are documented in several publications, e.g., "Emission Inventory Summary Report" (August 1976) and "Method of Projection" (May, 1977). Generally, the projections assume "normal" growth in the region consistent with the demographic projections made by ABAG. Transportation and mobile source emission projections were made jointly by ABAG, MTC and CARB. Again, these projections reflect anticipated growth in the region as forecast in the ABAG Series 3 projections.

Meteorological Assumptions. The data used in the LIRAQ analyses assume July 26, 1973 prototype meteorology. In essence, it assumes the meteorology which occurred on July 26, 1973 is typical of conditions conducive to adverse air quality in the region and capable of being repeated in 1985 and 2000. Additional prototype days are recommended for analysis in the continuing planning process.

Air Pollution Control Programs. The AQMP has assumed that existing control programs would continue to be implemented. It has also assumed that programs which have been adopted for implementation in future years will be carried out as currently scheduled. Of major significance in this latter category are the motor vehicle emission control programs of EPA and the CARB.

In general, the air quality baseline projections assume air pollution control programs currently "on the books" or adopted and scheduled for implementation. There is one exception and it is an important one. The BAAPCD has had in effect for a number of years Section 1309 of Regulation 2; this regulation requires a permit review of new or modified sources of pollution (the new source review program is commonly

referred to as the NSR regulation). The NSR regulation can have a variable impact on air quality depending upon the stringency of the rule adopted, the amount of off-set required, the conditions for issuing or denying permits, and the response of new and existing industries to the requirements.

Because the NSR rule is so difficult to predict (i.e., being a review program with variable impact), all the projections made by ABAG, MTC and BAAPCD were consistent in assuming no NSR rule for the baseline projections. As described later, the effectiveness of NSR is assumed in the alternative control strategy analyses. The fact that this program can have a variable air quality impact provides the AQMP with flexibility in later years. This assumption and its importance in the overall AQMP strategy recommended is explained further in Sections 6 and 7.

Uncertainties in Assumptions and Analysis

There are two basic sources of uncertainty in the AQMP: uncertainties related to the projections and those arising from inaccuracies in the data and analysis tools used. Each of these sources should be considered in formulating the AQMP control strategies.

It should also be noted that uncertainties usually occur in two directions: They may result in either underestimates or overestimates of the control programs needed.

Forecasting Uncertainties. To prepare a long-range plan for attaining and maintaining air quality standards it is necessary to forecast what future air quality is likely to be, as well as what sources will contribute most significantly to future air quality problems. Such a forecast is required by federal regulations. In making these forecasts, a variety of assumptions must be made regarding how the region will grow, how effective existing air pollution control programs will be, and how future resources will be consumed. These assumptions have been documented in various AQMP Tech Memos, Issue Papers, and Projections Technical Advisory Committee (PTAC) Working Papers. Each assumption reflects some judgment, and alternative assumptions are always possible. The forecasting process for AQMP was designed to explicitly identify and discuss such assumptions before completion of the analysis, thus ensuring as much objectivity as possible.

The resulting forecasts indicate the most likely future of air quality in the region under various conditions. It is possible that trends will change or unexpected events will occur which would invalidate the forecasts. This is one reason for establishing a continuing planning program, for which the current AQMP would be an initial effort. In the meantime, decisions made now can and will affect future air quality. Despite the many assumptions which are made, a rigorous, objective forecast is a necessary key element of the AQMP.

Analytical Uncertainties. Independent of the difficulties related to forecasting future conditions are uncertainties inherent in the forecasting models. Models are used to better understand complex problems such as air pollution. Air quality models always have and will continue to contain inherent imperfections--this is a reflection of practical constraints on data acquisition, computer capacity, and the state of knowledge on the complex processes involved.

Despite the imperfect nature of modeling, the models being used in support of the AQMP are among the most sophisticated and most thoroughly tested models available. Verification tests of model performance have been conducted prior to and as part of the current AQMP effort. In addition, appropriate adjustments have been developed to temper model performance according to measured air quality data and expert judgment. The air quality modeling effort undergoes periodic review by a special modeling committee composed of modeling experts from the Lawrence Livermore Laboratory, California Air Resources Board, Bay Area Air Pollution Control District, Systems Applications Inc., U. S. Environmental Protection Agency, Metropolitan Transportation Commission, California Department of Transportation, and Association of Bay Area Governments. Thus, the resulting forecasts are as objective, rigorous, and accurate as possible at this time.

Section-5

ALTERNATIVE SOLUTIONS

Air quality improvements can be achieved in many different ways. As previously described, a variety of stationary and mobile source controls have already been implemented. This chapter inventories many of the still remaining control measures which might be considered for further air quality improvement. Many of the programs which are considered may in fact already be in existence, e.g., transit service, vehicle exhaust emission standards. What is considered then is a further strengthening or expansion of the program in place, e.g., more transit service, lower vehicle exhaust emission standards.

Because so many possibilities exist for consideration, the AQMP Joint Technical Staff and later the AQMP Advisory Committee were involved in screening the control options which were developed. The screening process led to a more manageable number of options which were evaluated further by the AQMP Joint Technical Staff. The control measures which have been recommended in Section 7 represent staff's best estimates of a program which will meet the program objectives and be acceptable to EPA and CARB.

The Environmental Management Task Force (EMTF) has expressed a number of concerns about the proposals recommended and how they were arrived at. These concerns can be summarized as follows:

- Completeness of the options considered.
- Process for screening the options.
- Criteria used to screen the options.
- Need for EMTF to have a wide range of options to choose from in developing the plan recommendations.

This section attempts to address all of the concerns expressed by EMTF. Both the process and the rationale used by staff to arrive at the plan's recommendations are presented. As this draft plan is debated by EMTF and the public, changes to the plan are anticipated. For example, EMTF may want to either delete certain recommendations or substitute options considered but not included in the plan. The material included in this section should facilitate such changes.

INVENTORY OF OPTIONS (OR CANDIDATE CONTROL MEASURES)

The first step in the process of developing alternative solutions to the air quality problems was to prepare an inventory of options (also referred to as the candidate control measures). The procedure used by the AQMP Joint Technical Staff was to have each participating agency develop a list of options for their area of expertise and/or responsibility. Thus, the work was divided as follows:

<u>Agency</u>	<u>Area of Expertise/Responsibility</u>
Bay Area Air Pollution Control District	Stationary Source Controls
California Air Resources Board	Mobile Source Controls
Metropolitan Transportation Commission	Transportation Controls
Association of Bay Area Governments	Land Use Management/ Development Controls

As the inventory of options was being developed, input was requested from the AQMP Advisory Committee to ensure the list was as complete as possible.

Completeness of the Options Considered

Because of the very wide range of options which could have an impact on air quality, it is impossible to compile an absolutely complete list of options. However, the AQMP Joint Technical Staff did compile an exhaustive list of options. These options were generally viewed by staff as offering potential air quality improvement and worthy of some level of technical review and analysis.

As an example of how the options were viewed to be incomplete, an AQMP Advisory Committee member felt "population measures" should be considered in the AQMP. Later, when this issue was discussed by the EMTF, it was generally agreed that population control measures were inappropriate as a serious or viable option for improving air quality. Rather what needed to be spelled out to EMTF and the public were the air quality implications of the high and low population range forecast for the region. This has been done by staff.

The AQMP takes into consideration the inherent uncertainty of population forecasts. For the year 2000, both the high (approximately 6.1 million people) and low (approximately 5.4 million people) populations are projected to be equally plausible. Stated differently, either projection or anything in between is likely to occur given our current trends. The air quality implications are also clear. More people will mean more air pollution. All other things being equal, air quality will be worse in 2000 with 6.1 million residents than with 5.4 million residents.

To achieve the same level of air quality, the implication is a higher level of control will be needed to accommodate more people. Conversely, a lower level of control will be needed if there are fewer people in the region. The plan recommendations provide for flexibility to deal with this inherent uncertainty and yet provide for meeting and maintaining the air quality standards.

Other examples of control measures which the EMTF wanted considered in the process were:

- Fuel rationing (including gasoline rationing).
- Energy conservation (industrial and residential).
- Indirect source review (as an enforcement mechanism to implement the land use management and development controls).

These control measures and several others are discussed in the following section.

Control Measures Considered

Table 10 lists the inventory of air pollution control measures considered in developing the AQMP. The inventory is organized according to the participating agencies which prepared the component parts.

The control measures for stationary and mobile sources have traditionally been direct controls. As such they can be specified quite precisely. Many of the transportation controls and land use management measures are indirect controls. Thus, they tend to be described in more general terms. This is especially true for the land use management actions proposed. In Section 7, the basic objectives of the land use management program are presented. Simply stated the objective is to reduce the number and length of automobile trips and to increase transit use in order to decrease the amount of regional automobile travel. This can be accomplished by achieving more compact development in the region by the year 2000. Recommendations are presented for policies and actions which might begin to achieve these objectives. Clearly there may be other policies and actions which can achieve the stated objectives. What EMTF and the public must determine is how to achieve the objectives in the most efficient manner acceptable to local governments and the general public.

PROCESS FOR SCREENING THE OPTIONS

Having developed an inventory of about 100 control measure options, the AQMP Joint Technical Staff proceeded to screen the options down to a more manageable size. Again, the agencies which developed the initial lists were primarily responsible for the initial screening. During the screening process the AQMP Advisory Committee was also asked to comment on which measures should be included for more detailed study. They were also given the opportunity to suggest other measures which may have been left out of the original inventory.

In conducting the screenings, the AQMP Joint Technical Staff attempted to avoid political judgments regarding a measures' implementability. The list of control options was screened primarily on the basis of technical effectiveness. Gas rationing serves as a good example. Nobody would debate that gas rationing could be an effective way of controlling air pollution. The debates about gas rationing center on its public and political acceptability and implementability. The AQMP Advisory Committee argued over whether gas rationing should or should not be screened out. In the end it was included in the screened options because it is technically effective. EMTF and the public could judge its political merits and public acceptability.

Table 10. Inventory of Air Pollution Control Measures

I. Stationary Sources

1. Require the use of high solid coatings where practical.
2. Require the use of water based coatings where practical.
3. Adopt the CARB standards for organic liquid storage.
4. Adopt closed system organic liquid storage with vapor recovery.
5. Require vapor recovery on small solvent users.
6. Adopt organic solvent regulation developed by the CARB Organic Solids Committee.
7. Enact a new maximum SO₂ emission limit of 300 ppm.
8. Require reduced sulfur content in fuels to .025%.
9. Adopt NO_x controls for non-highway and construction equipment.
10. Adopt NO_x limits for all new boilers.
11. Adopt lower particulate loading requirement - 0.05 to 0.1 grains/SCFM.
12. Adopt lower process weight allowable scale.
13. Adopt lower process weight maximum allowable scale.
14. Adopt best available control technology (BACT) regulation for existing sources with a time scale for compliance.
15. Adopt BACT regulation for all sources in lieu of emission concentration limits.
16. Adopt BACT regulation for all sources in addition to emission concentration limits.
17. Adopt a modern process technology rule aimed at promoting modernization of the areawide plant. This might, for instance, suspend a BACT rule for an agreement to modernize a plant with BACT included in modernized version. The intent of such a regulation would be to encourage modernization of old plants with new plants having improved pollution control technology.
18. Extension of current BAAPCD requirements to smaller operations, i.e., fewer exemptions.
19. New Source Review (NSR) - continue present rule.
20. New Source Review - Adopt 100% off-set policy.
21. New Source Review - Adopt 110% off-set policy.
22. New Source Review - Adopt a sliding scale for emission off-set.
23. NSR Options 20, 21 or 22 with a limited area for emission off-set.
24. NSR Options 20, 21 or 22 with inter-pollutant emission off-set.
25. NSR Options 20, 21 or 22 with no inter-pollutant off-set or inter-pollutant off-set governed by location, etc.
26. NSR Options 20-25 qualified so that no credit is allowed for emissions that are in excess of other limitations.
27. NSR Options 20-25 with arrangement for off-set banking, allowing a prospective new source credit for emission reduction off-set achieved beyond that required by existing regulations.
28. Adopt regulations to promote industrial energy conservation.
29. Plant operation scheduling:
 - a) Seasonal scheduling to reduce polluting operations during critical weeks or months as determined by meteorology.
 - b) Scheduling maintenance down time and vacations, possibly short downs, to reduce pollutant load at critical times.
 - c) Interruptable operation dependent upon air quality conditions.
- d) Stagger operations between plants to spread operation over seven days instead of five. Assign plants a 5 day week starting on any one of the seven days, possibly with some on 4 day 10-hour operation.
- e) Stagger work hours. For instance, run coating lines only between 4 PM and midnight instead of 7 AM to 3 PM.
- f) Schedule reduced work days during the smog season with or without longer days during less critical seasons. Rationing the pollution absorbing capacity.
30. An air monitoring and meteorological analysis to identify and recommend mitigation measures, for certain localized problems.
31. Adopt particulate regulation based on particle size.
32. Replace throw-away container with re-usable containers.
33. Burn solid waste near point of generation, to reduce long hauls.
34. Apply 1309 with modified trade-off of 1311 and 1311-2 clearly described as an option.
35. Requiring some sort of retrofitting on older plants. Apply BACT to newer plants through permit system.
36. Penalty charge or tax based on amount of emission to encourage reduction.
37. Lowering the Reid vapor pressure of gasoline to reduce hydrocarbon emissions from storage, handling and use of motor vehicle grade gasoline.

II. Mobile Sources

1. Implement an evaporative emissions retrofit program for all vehicles.
2. Implement a catalytic retrofit program for post-71' vehicles able to operate on unleaded gasoline.
3. Adopt more stringent application of compliance procedures.
4. Adopt more comprehensive new and used motor vehicle surveillance program.
5. Adopt a mandatory vehicle inspection and maintenance program for light and heavy duty vehicles.
6. Adopt more stringent evaporative emission standards.
7. Implement a heavy duty gasoline exhaust emission retrofit program.
8. Adopt more stringent exhaust emission standards for new light and heavy duty vehicles.
9. Promote the use of new or modified fuels.
10. Promote the use of alternative power sources.
11. Establish emission standards for other mobile sources such as construction equipment, locomotives, ships, or recreational vehicles.

III. Transportation Controls

1. Measures to Improve Traffic Operations
 - A. Improve Traffic Flow
 - 1) Computerized traffic control
 - 2) Ramp Metering
 - 3) Traffic engineering improvements
 - 4) Off-street freight loading
 - B. Reduce peak-period traffic volumes
 - 1) Staggered work hours
 - 2) Four day work week
 - 3) Off-peak freight delivery
2. Measures to Reduce Vehicle Use
 - A. Restrict Vehicle Ownership
 - 1) Additional license fee
 - 2) Registration limits
- B. Management of Auto Access
 - 1) Better enforcement of parking regulations
 - 2) Limit on number of parking spaces
 - 3) On-street parking prohibited during peak hours
 - 4) Area license
 - 5) Auto-free zones
 - 6) Gas rationing
- C. Increase Cost of Auto Use
 - 1) Road pricing
 - 2) Increased parking costs
 - 3) Parking fee for shopper
 - 4) Eliminate free employee parking
 - 5) Increased gas tax
 - 6) Increased tolls
 - 7) "Smog charges"
- D. Reduce the Need to Travel
 - 1) Communications substitutes
 - 2) Goods movement consolidation
3. Measures to Encourage Alternative Model of Travel
 - A. Increase Transit Ridership
 - 1) Additional transit service
 - 2) Fare reductions
 - 3) Improved comfort
 - 4) Bus and carpool lanes
 - B. Encourage Pedestrian Mode
 - C. Encourage Bicycle Mode
 - D. Encourage Ride Sharing
 - 1) Toll reduction for carpools
 - 2) Preferential parking and carpools
 - 3) Carpool matching information
 - 4) Assist vanpool formation
 - E. Promote Para-Transit Alternatives

IV. Land Use Management/Development Controls

- More effective management of all five major aspects of land development through coordinated action by cities, counties, special districts, or regional and State agencies to reduce the magnitude and frequency of auto travel:
1. Timing - expand the presently very limited application of timing controls such as growth sequence zoning, building permit quotas, staging of sewer and water infrastructure and plant capabilities, etc.
 2. Quantity - expand the presently scattered application of quantitative controls on development such as performance standard zoning and limited sewer and water infrastructure and plant capacities.
 3. Location - Improve the presently inconsistent application of controls on the location of development such as coordinated management of infrastructure location, annexations, public land acquisition, agricultural preserves, hillside and soil conservation, and development moratoria.
 4. Density - Encourage transit usage and other non-auto modes with coordinated density policies among local jurisdictions through the application of innovative density zoning mechanisms (slope density, building height regulations, etc.) fully coordinated with service capacities and commitments.
 5. Type - Reduce home-to-work & home-to-non-work travel by encouraging more land use mix, especially in terms of housing/jobs balance.

The list of screened options was presented to EMTF in June, 1977 during a presentation of alternative air quality strategies. At that meeting EMTF approved the screened listing of control measures for use in developing alternative air quality strategies. EMTF reserved the right to consider other measures at a future date, but directed staff to continue the detailed analysis of the measures presented. These control measures were to be grouped into a series of control strategies for testing of their air quality effects. This has been done by staff and is described in the following chapter.

OPTIONS CONSIDERED BUT NOT INCLUDED IN THE PLAN

Using the screened inventory of control measures as a starting point, the AQMP Joint Technical Staff analyzed the remaining control options further. Since it was clear by now that the focus for this plan was meeting the oxidant standard, additional measures were eliminated. For example, in some of the earlier progress reports, several measures were included to control sulfur dioxide emissions. Since the more detailed evaluation of the sulfur dioxide problem is proposed for the continuing planning process, these measures were dropped from this current plan. Another example of control measures temporarily deferred is the use of best available control technology for sulfur dioxide and particulate controls. The revised best available control technology proposal concentrates on reducing hydrocarbon emissions from a number of categories.

Tables 11-13 summarizes the options considered in the AQMP but not included as part of the plan. The land use management or development controls are not listed in these tables. As previously noted, land use management and development controls are recommended to achieve specific objectives--reducing the number and length of automobile trips to reduce regional travel. Specific measures were not formulated in the same sense as the technological types of controls. Rather, policies and actions which could be adopted to reduce vehicle travel are proposed. Reviewers of this plan need to address several issues:

- Will the proposed land use policies and actions achieve the objective of reducing regional travel?
- Are there other policies and actions which should be included?
- Are there land use policies and actions included which should not be?

The important regional issue is how best to work cooperatively to bring about a long range land use pattern which reduces the region's projected travel.

Table 11. Options Considered But Not Included in the Plan (Stationary Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
1. Enact new maximum SO ₂ emission of 300 ppm.	Affects sulfur recovery, sulfuric acid plants and combustion operations burning fuel oil, etc.	0	0	BAAPCD Engineering Estimate	Deferred for closer examination in the continuing planning process (CPP); this program is directed at controlling SO ₂ .
2. Reduce fuel sulfur content to 0.25%.	Affects sulfur recovery sulfuric acid plants and combustion operations burning fuel oil, etc.	0	0	BAAPCD Engineering Estimate	Deferred for closer examination in the continuing planning process (CPP); this program is directed at controlling SO ₂ .
3. Adopt NO _x controls for non-highway and construction equipment.	Primarily modifications on agricultural tractors, construction equipment, steamships, locomotives and two cycle engines.	0	0	BAAPCD Engineering Estimate	Possible conflict with the proposed oxidant control strategy. Requires closer examination.
4. Adopt NO _x limits for all new boilers.	Long term (15 to 30 years) program to require a new NO _x limit on boilers < 250 million BTU/hr. rating.	0	0	BAAPCD Engineering Estimate	Possible conflict with the proposed oxidant control strategy. Requires closer examination.
5. Adopt lower particulate loading - 0.1 to 0.05 gr/SCFM.	Primarily a change from any cyclone control to BAG House or Electrostatic Precipitator on 1000's of small operations.	0	0	BAAPCD Engineering Estimate	Deferred for closer examination in the CPP, this program is directed at controlling particulates.
6. Lower process weight allowance scale.	Less than 100 sources (e.g., Catalytic Crackers, Fluid Coking, Kilns and Fertilizer Plants) affected.	0	0	BAAPCD Engineering Estimate	Deferred for closer examination in the CPP, this program is directed at controlling particulates.
7. Lower process weight maximum.	Less than 100 sources (e.g., Catalytic Crackers, Fluid Coking, Kilns and Fertilizer Plants) affected.	0	0	BAAPCD Engineering Estimate	Deferred for closer examination in the CPP, this program is directed at controlling particulates.
8. Options 14-18 (Table 9) are all forms of BACT.	Best Available Technology with minor variations.	Very Significant		BAAPCD Engineering Estimate	Included in the AQMP (See Specific Proposals and Control Categories covered).

Table 11. (con't). Options Considered But Not Included in the Plan (Stationary Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
9. Options 19-27 are all forms of New Source Review.	Review of new or modified sources; many variations as described.	Significant		BAAPCD Engineering Estimate	Included in the AQMP (See Discussion in Chapter 7).
10. Institute a comprehensive program to reduce energy use.	Efficient building heating and air conditioning, reduction of illumination & display lighting - promote heat recovery.	Not Significant		BAAPCD Engineering Estimate	Will reduce emissions but would be primarily fuel conservation measures; it is not significant as an organic control.
11. Plant operation scheduling - (many options as described in Table 9).	Seasonal (day, week, month) scheduling including close attention to interruptable operations & staggering operations on 7 vs. 5 day/week.	Not Significant		BAAPCD Engineering Estimate	Generally difficult due to social-economic factors and not a factor in reducing organic emissions. Does not conform with Federal and State approach of <u>continuous, positive</u> emission reduction program.
12. Air monitoring combined with meteorological analysis.	Approach relies on accurately predicting problems and implementing needed controls.	Not Significant		BAAPCD Engineering Estimate	Isolates air pollution problems--not significant in organic emission control. Again, is not a continuous, positive emission reduction program.
13. Adopt particulate regulation based on particle size.	Self explanatory.	0	0	BAAPCD Engineering Estimate	No effect on organic emissions (particulate control proposal).
14. Replace throw-away container with reusable containers.	Self explanatory.	0	0	BAAPCD Engineering Estimate	No appreciable effect on organic emissions.
15. Burn Solid Waste near point of generation to reduce long hauls.	Self explanatory.	Not Significant		BAAPCD Engineering Estimate	Not a significant source of organic emissions; low potential benefits.
16. Apply 1309. with modified trade-off of 134 & 1311.2.	New Source Review with clearly defined variations.	Significant		BAAPCD Engineering Estimate	NSR Rule included in AQMP.

Table 11. (con't.) Options Considered But Not Included in the Plan (Stationary Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
17. Require some sort of retrofitting on older plants.	Applies BACT to newer plants plus retrofit of existing plants on a time schedule.	Significant		BAAPCD Engineering Estimate	Included in AQMP as NSR and BACT. Reducing emissions in this manner and permit additional growth in region.
18. Penalty charge or tax based on amount of emission to encourage reductions.	Emission charge for contaminants to effect industrial control changes to BACT.	Not Significant		BAAPCD Engineering Estimate	Open to charge that large companies can buy emission allowance.
19. Lowering the Reid Vapor Press of gasoline to reduce hydrocarbon emissions from storage & handling vehicle.	Affects ~ 4 million vehicles, 6000 service stations, 60 bulk plants and all refineries & some chemical plants.	30	35	BAAPCD Engineering Estimate	An ongoing American Petroleum Institute study indicates that this option is not viable. When formal report is available, this option should be re-examined.

Table 12. Options Considered But Not Included in the Plan (Mobile Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
o Implement an evaporative emissions retrofit program for all vehicles, and/or recommend catalytic retrofit program for post '71 vehicles able to operate on unleaded gasoline.	Retrofit programs consist of the addition of a new item, or the modification or removal of an existing item of equipment on a vehicle after its initial manufacture.			Reductions from evaporative retrofit programs assume that a 25% reduction can be attained from pre-1980 vehicles. Reductions from catalyst programs assume 50% reduction can be attained by retrofitting non-catalyst vehicles. There would be no benefits by 2000 because the affected vehicles will have been retired.	Retrofit programs become less effective as old pre-controlled cars are retired. Thus, this is a short term measure. By 1975 the pre-catalyst vehicles (1971-1975) and pre-2gm/test vehicle (i.e., pre-1980) will only represent about 2% and 20%, respectively, of the total vehicle miles travelled. Since these percentages decrease rapidly thereafter the high cost and the short term benefit of this program does not appear to warrant it.
	In the Bay Area all non-exempt vehicles undergoing change-of-ownership or initial registration require the installation of:				
	(1) An NO _x control device for '66-'70 models.				
	(2) An exhaust emission control device for '55-'65 models.				
	(3) A crankcase emission control device for '55-'62 models.				
	There have been no further developments of any retrofit programs to date.				
	<u>Type of Retrofit Program</u>				
	Evaporative	~ 4	Not		
	Catalyst	~ 6	Applicable		
o More stringent certification of compliance procedures.	New vehicles from each engine family are randomly selected from the manufacturers and tested for their emission characteristics by the CARB. More rigorous certification testing procedures could be employed to reduce maintenance requirements of engine components which influence emissions or, where possible, eliminate this maintenance completely. More stringent warranty conditions on emission control systems could also be utilized.	-	-	The air quality benefits could be assumed to be the same as those reductions shown for the motor vehicle inspection program in 2000. This measure could not be feasibly implemented by 1985.	This measure could eventually replace the need for a Motor Vehicle Inspection Program (MVIP). The new technology that would be required to satisfy this control measure would take years to develop. Since this time frame is not known, it was decided to keep MVIP through the year 2000.

Table 12. Options Considered But Not Included in the Plan (Mobile Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
(Continuation of previous Recommendation)	CARB has recently adopted regulations in certification test procedures for 1980 and later model vehicles that will require manufacturers of vehicles to make carburetors almost tamper-proof. This measure would recommend more stringent certification requirements which would promote changes in vehicle designs to minimize the need for maintenance and the possibility of tampering.				
o Adopt a more comprehensive new motor vehicle surveillance program.	<p>Currently, all production vehicles are checked at the end of the assembly line to ensure that the emission control systems are properly installed and functional. The manufacturer also tests 2% of all vehicles using prescribed Federal test procedures. ARB staff periodically examine the manufacturers' quality control facilities. In addition, all new vehicles at dealerships and preparation centers are spot-checked.</p> <p>Title 13 of the California Administrative Code gives ARB the power to implement standards for engine setting tolerances, idle emissions and inspections of control systems to which new and used vehicles must conform as a condition of sale.</p> <p>Cross-check testing could be randomly performed on production vehicles currently being tested by the manufacturers. Dealership inspections could be ex-</p>	0	0	The benefits of this program are assumed to be achieved by the proposed Motor Vehicle Inspection Program (MVIP).	Since all newly acquired vehicles must be registered with the Department of Motor Vehicles, these vehicles could be required to satisfy MVIP requirements before such registration. Thus, it is assumed that the MVIP would eliminate the need to step-up this existing program.

Table 12. Options Considered But Not Included in the Plan (Mobile Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
(Continuation of previous Recommendation)	panded to include used as well as new vehicles to deter maladjustments being made to maximize vehicle performance.				
o More stringent evaporative emission controls.	<p>Evaporative emissions from the fuel system are produced by two effects, (1) daily ambient atmospheric temperature variations and (2) higher fuel temperature after vehicle usage.</p> <p>Since 1970, gasoline evaporative emission control systems have been installed on all new cars sold in California to reduce emissions from the carburetor and fuel tank. Control of heavy duty vehicles begin with 1983 model year.</p> <p>More stringent evaporative emission standards have been adopted for 1980 and subsequent model year vehicles. A new certification test procedure will also be used beginning in 1978.</p>	0	0	The 1980 standards are already close to vehicle background levels. Thus further reduction would result in not appreciable benefits.	Stabilized background evaporative emissions, from painted or greased surfaces or vinyl upholstery, are thought to represent 40-50% of the 2 grams per test standard promulgated for post-1980 vehicles. Thus, further reduction would not be significant.
o Promote use of new or modified fuels.	The modification of fuels has been and continues to be investigated in an effort to come up with an efficient non-polluting fuel. Much experimentation has also been done on the use of alternative fuels such as methanol, hydrogen, and other types of fuels.	-	-	Not Applicable	Since new technological developments in emission control is a result of more stringent emission standards, this measure may be a result of the proposed control measure to reduce emission standards by 50%. Thus the effect would be comparable.

Table 12. Options Considered But Not Included in the Plan (Mobile Sources)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
o Promote use of alternative power sources.	The development of non-polluting power sources has progressed rapidly over the last 5-10 years. Unfortunately there has not been a strong push for mass producing any of these engine types.	-	-	Not Applicable.	Same rationale as for "new or modified fuels."
o Emission standards for other mobile sources.	This would include the adoption of emissions standards for mobile sources such as construction equipment, locomotives, ships, or recreational vehicles.	-	-		Emissions from off-highway mobile sources for 1985 are 50.3 t/d for HC, 73.7 t/d for NO _x , and 322.6 t/d for CO, and for 2000 75.4 t/d, 94 t/d and 389.3 t/d, respectively. Staff believes that these sources may be controllable, but there does not seem to be any available information as to the extent of this control. Thus this measure was dropped at this time due to lack of adequate information, but should be looked at in future updates of the plan.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)					
RECOMMENDATION	DESCRIPTION	1985	2000	BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
I. MEASURES TO IMPROVE TRAFFIC OPERATIONS					
A. IMPROVE TRAFFIC FLOW					
This general class of controls is designed to improve air quality by smoothing the flow of traffic. Since certain emissions increase due to "stop and go" traffic conditions, smoothing traffic flow would help reduce overall emissions. Traffic flow improvements are particularly suited to alleviating carbon monoxide problems. However, because of increasingly stringent motor vehicle emission standards for new cars, CO is not expected to be a long-term regional problem in the Bay Area, although local "hot-spots" may surface. These can be dealt with on an individual basis.					
1. Computerized Traffic Control	Traffic flow would be improved through a system of computerized traffic signals on selected arterial streets.	Negligible	-	Emissions vs. Speed Curves	This measure was dropped early in the analysis because only very small reductions in oxidant precursors would be achieved through speed improvements, especially considering the small portion of regional traffic that would be affected. Also, the improved flow might induce additional travel, which would offset any gains in air quality. A quantitative assessment was not conducted.
2. Ramp Metering	Ramp metering is an effective operational tool which can, under appropriate conditions, promote optimum use of a transportation corridor. Its use also tends to improve air quality in two ways: 1) by improving the flow of traffic and 2) by providing bus bypass lanes at ramps with queues of traffic and thus a time saving to those using buses, which tends to encourage a modal shift. However, if congestion on a freeway is eliminated, there is the possibility that, in the absence of any other land use or transportation actions, additional long-distance trips could be generated.	(See measure for Bus/Carpool lanes)			<p>This measure has been combined with bus and carpool lanes because of possible travel-inducing effects if it were implemented alone.</p> <p>This measure has been recommended for inclusion in the draft AQMP. More details may be found in the recommended strategies summaries.</p>

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
3. Traffic Engineering Improvements	Traffic flow can be improved by a number of small projects which would redesign inter-sections or small street segments. However, if overall capacity were increased, and more trips generated, there could be a negative air quality effect.	Negligible	-	Emissions vs. Speed Curves	This measure was dropped in the first screening because it would affect only a small portion of travel, and any air quality effects would likely be insignificant. A quantitative analysis was not conducted.
4. Off-Street Freight Loading	Zoning regulations would specify off-street freight handling, which would improve traffic flow and hence air quality.	Negligible	-	Emissions vs. Speed Curves	The improved flow would have very little effect on oxidant precursors. Thus this measure was dropped in the initial screening without qualification.
B. REDUCE PEAK PERIOD TRAFFIC VOLUMES					
Much of the peak oxidant problem can be traced to emissions generated during the morning hours. This is due to the time required for photochemical reactions to take place. Any reduction or spreading of these early morning emissions could possibly reduce the intensity or shift the location of peak oxidant concentrations. However, current knowledge of oxidant formation indicates that a very large shift in time would be required and moreover the measures in this category would be difficult to implement to the degree necessary to have this significant effect.					
1. Staggered Work Hours	This program would shift the daily work schedule so that all employees would not arrive and leave at the same time. This could take the form of "staggered hours," where subgroups of a total work force operate on a fixed schedule, or "flex-time," where employees are given the option of determining their own hours within certain limits. This measure could improve air quality by a) reducing congestion, b) spreading early morning emissions, and c) providing employees with an opportunity to adjust their schedules to accommodate other modes of travel.	Negligible	-	Previous studies and MTC staff judgement	This measure was eliminated at the initial screening because it would redistribute auto trips, rather than eliminate them. Although the air quality benefits would be slight, it may be desirable to implement this strategy for other reasons, such as reduction in congestion.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
2. Four Day Work Week	The standard work week would be shortened to four days, with the work day lengthened and/or the weekly hours worked shortened. One-fifth of the commute travel could be eliminated, but the additional leisure time would probably generate other recreational or shopping trips.	Negligible	-	Previous studies and MTC staff judgement	Because of the potential for additional trips, it was felt that this measure would have only a small effect on air quality, and it was therefore eliminated during the initial screening.
3. Off-Peak Freight Delivery	Freight deliveries would be prohibited during peak periods. This would both reduce peak period traffic and also improve traffic flow by removing the slower vehicles and the trucks stopped while loading.	Negligible	-	Previous studies and MTC staff judgement	Only a small percentage of regional travel would be affected by this measure, and so any air quality improvement would be virtually undetectable. This measure was therefore dropped from further consideration during the initial screening.

II. MEASURES TO REDUCE VEHICLE USE

A. MEASURES TO RESTRICT VEHICLE OWNERSHIP

This strategy is designed to reduce travel by limiting the number of vehicles.

1. Additional License Fee.	This measure could take a number of forms. It could be a tax increase on all cars, or one which would put a progressively heavier tax on the more polluting cars. Another alternative would be to tax second or third cars in a household and so reduce mobility.	Negligible	-	Previous studies and MTC Staff judgement	Although this measure is appealing from an implementation standpoint, at least one study* has indicated that an annual fee would not be a significant factor in a decision to own or drive a car, unless the fee was extremely high. This measure was thus dropped in the initial screening.
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*R.H. Pratt Associates, Inc., "Transportation Controls for Air Quality Improvements in the National Capitol Region," October 1976.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
2. Registration Limits.	Instead of taxing vehicles with higher pollution potential, this measure would set limits on the numbers of such vehicles which could be registered. The EPA promulgated TCP proposed a ceiling on motorcycle registrations, but this measure was dropped in final version.	Negligible		Previous studies and MTC Staff judgement	The implementation and equity problems of this measure are formidable. Because of this, the program could not be set up at a scale which would have a significant effect on air quality. This measure was eliminated during the initial screening.
B. MANAGEMENT OF AUTO ACCESS					
This strategy would discourage auto use by restricting the areas where autos can travel or park.					
1. Better Enforcement of Parking Regulations.	There are many current parking regulations which, if enforced, could discourage certain auto trips. Notable among these are the restrictions on long-term parking which could persuade some commuters to take transit. Other actions, such as enforcement of truck loading zones, could result in a smoother flow of traffic.	Negligible		MTC staff judgment	Because staff believed that the current number of violators was relatively low, the resultant effect in air quality would be small. However, this measure could be effective in jurisdictions where enforcement is currently lax. The measure was eliminated during the initial screening.
2. Limit Number of Parking Spaces.	The intent of this measure is to reduce the available parking and so limit the number of autos which can effectively use the controlled area. There are two implementation options: (a) limit the construction of new parking facilities, and (b) cut back the number of parking spaces already available.	~ 0.4	*	Travel Model Analysis	The effect of freezing parking in the CBD's was investigated. Although this measure is effective, it was not included because of the potential for inequity between the large downtown areas and the smaller cities. However, it does remain a possible option.
3. Prohibit On-Street Parking During Peak Hours.	This measure is designed to improve air quality primarily by improving the flow of traffic. It also serves to discourage certain trips since it limits the available parking.	Negligible		MTC staff judgment	This measure was not pursued since it is currently practiced by the major cities in their CBD's.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
4. Area License	A special license would be required to bring a car in- to certain designated areas. This would encourage a shift to other modes.	Variable		Previous studies and MTC staff judgement	In the past few years there has been increased interest throughout the world in the possibility of imposing user charges to discourage automobile travel in major urban areas. Singapore instituted a program which has been successful but no cities in Europe or North America have tried this concept. A similar type of program was under discussion in Berkeley but was not pursued. Although congestion pricing would certainly be effective in reducing auto-related emissions, this measure was eliminated during the initial screening because of equity problems, implementation problems and public acceptability. It was felt that a similar effect could be obtained, at least in the CBD's, by increasing long-term parking rates.
5. Auto Free Zones	This measure involves the designation of areas within a city (e.g., CBD's where vehicles are prohibited, with the exception of buses, taxis, and emergency vehicles). This technique can result in an improved pedestrian environment and would encourage people to use transit for the entire trip. To develop traffic, necessary freight movements, improved transit access, and, in some cases, parking structures on the fringes. This concept has proved successful in a number of cities, most in Europe. In the U.S., the major examples of such zones have been shopping malls.	~ 0.1	*	Travel Model Analysis	An area within the San Francisco CBD was analyzed as a potential auto control zone. This roughly corresponds, to the area recommended in the revisions to the Transportation Element of the San Francisco General plan. [†] This measure is recommended for implementation in San Francisco. The experience gained in this project will determine its potential for other areas in the region. A more detailed description of this measure may be found in the recommended strategy summaries. [†] Adopted by the San Francisco City Planning Commission. Resolution No. 7657, January 20, 1977.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
6. Gas Rationing	This is generally considered the "ultimate" measure. The supply of gasoline is limited in an effort to cut travel and thus pollutant emissions. This measure would have significant administrative problems.	Variable		Joint Technical Staff estimate	This measure was not considered for inclusion in the draft AQMP because of the significant administrative problems and public acceptance problems which would surface. Overall <u>fuel</u> rationing has been suggested as an alternative to gas rationing in an effort to spread the burden over all segments of the economy. It should be noted that since autos will constitute only 15% of regional hydrocarbon emissions in 1985, a 20 percent cutback in gasoline availability would reduce regional hydrocarbon emissions by approximately 23 tons.

C. MEASURES TO INCREASE COST OF AUTO USE

Another way of discouraging auto use is to increase the cost of auto commuting relative to transit or carpooling. However, it generally takes a fairly large increase to effect a significant shift to transit. The more effective pricing strategies are those which serve as daily visible reminders of the real costs of auto commuting.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
1. Road Pricing Techniques	This measure could be implemented in two distinct ways. In one, a fee would be charged for the use of certain roads. This is similar to a toll, except that it is more widespread and would likely not be collected at a tollbooth. Instead, some system of in-car meters or electronic scanning devices might be used as automatic billing devices. The second form is a congestion toll, where the rates would increase with the level of congestion.	Negligible		Previous studies and MTC staff judgement	These measures have not yet been tried as air quality strategies. The technology is not readily available for the first and the second is still fairly new and untested. For this reason, and because of problems in public acceptability, this measure was dropped in the initial screening. The discussion included under measure B(4) is also applicable to this measure.
2. Increased Parking Costs	The purpose of this measure would be to discourage auto use by increasing the overall commute cost via additional parking charges. A special parking tax of 35 percent, to be levied on all vehicles parking between 6 and 10 a.m., has been proposed.	~ 0.3	*	Travel Model Analysis	The 6-9 a.m. period was selected to minimize the additional burden on those driving for non-work purposes. This measure has been recommended for implementation. Additional information is contained in the recommended strategy summaries.
3. Minimum Parking Fee at Large Shopping Center	Most of the measures that were considered focused on the work trip. Other trips, such as shopping, are important in the formation of air pollution but are not as susceptible to diversion to transit. However, many of these trips are made to purchase only one or two items. If the shopper were to consolidate these single trips	See Description	and Comments		Staff was unable to quantify the effectiveness of this measure because of the lack of experience with this type of action. However, we estimate that shopping trips in 1985 will generate 53 tons of HC, 826 tons of CO, and 39 tons of NOx daily. This is significant, and therefore this measure was recommended.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
(Continuation of previous Recommendation)	into one or two weekly trips, the air quality effect could be important. To encourage this consolidation of trips, a minimum 50¢ parking fee at shopping centers that maintain over 500 parking spaces was proposed.				
4. Eliminate Free Employee Parking	Employers located outside the CBD's virtually always provide their employees with free parking. To encourage these employees to shift to transit or carpools, this measure specifies a \$1.00 parking fee be levied at all employee lots of 500 or more spaces.	~ 0.9	*	Travel Model Analysis	Although these reductions are relatively high, it was felt that the current lack of transit access to many industrial areas would be a hardship. Therefore, this measure is not recommended at this time.
5. Additional Gasoline Tax	The gas tax would be raised to reduce the demand for vehicular travel. The extra revenue would be used to finance transit improvements or other non-auto alternatives. Unfortunately, the energy crisis of 1974 demonstrated that, even with a rather large increase in cost, the use of autos did not decrease significantly. This experience showed that a 10% increase in pump price facing the consumer would cut the demand probably 1.5%. In the long run, the application of this measure would probably produce a shift toward smaller, more fuel-efficient cars. The imposition of this measure raises questions of equity, since the poor and those not having access to transit would be penalized most severely.	< 0.1	—	Travel Model Analysis	A 15¢/gal increase in the gas tax would reduce HC emissions in 1985 by less than 0.1 ton/day. The CO reduction was 0.8 tons/day with NOx reduced less than 0.1 ton/day. This measure was eliminated during the secondary screening.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
6. Increased Tolls.	Bridge tolls would be increased to reduce the volume of autos using the facility and to generate revenue which could be used to finance improvements in the transit system. MTC was recently given authority over the level and use of tolls on the trans-bay bridges. Tolls on the Bay, San Mateo, and Dumbarton bridges were recently raised to 75¢. The Golden Gate Bridge District has just adopted a \$1.00 toll.	~ 0.2	*	Travel Model Analysis	A peak toll of \$1.25, with an off-peak toll of \$1.00, would reduce HC by 0.2 tons/day, CO by 3.1, and NO _x by 0.2 (1985 emissions). In addition, over \$12 million additional revenues would be generated annually, which could be used for transit improvements. This measure is therefore recommended.
7. "Smog Charges."	This measure would assess an additional charge on the auto driver for the pollution generated by the automobile, thus encouraging a shift to other forms of transport or to less polluting cars. The implementation could be done through some of the measures already mentioned, such as the gas tax or registration fee, possibly accompanied by some rebate scheme for those autos with superior emissions control equipment.	Negligible		MTC staff judgment	The effectiveness of this measure was judged to be similar to that estimated for the additional gas tax. An extremely high charge was thought necessary to effect significant reductions in auto use - the measure was therefore eliminated during the secondary screening.

D. MEASURES TO REDUCE THE NEED TO TRAVEL

This strategy is designed to maximize or eliminate unnecessary travel. Unfortunately, the effectiveness and feasibility of these types of measures are uncertain.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
1. Communications Substitutes.	Certain trips could be eliminated by using other means of communication. This could include business trips as well as shopping trips. The technology for visual communications is becoming more available. However, the extent to which the public will adapt to these new systems is uncertain. The rapid growth in electronic communications in the past decade has not reduced the need to travel.		Uncertain, probably negligible	See comments	This measure was eliminated in the initial screening because its proven effectiveness in the near term is doubtful.
2. Goods Movement Consolidation.	This measure would reduce truck travel by consolidating freight deliveries. Basically, the concept is to have one terminal where the freight is delivered and sorted, and then small trucks would complete the delivery. The measure would thus decrease truck VMT and probably also reduce auto emissions as well by permitting a smoother traffic flow.		Negligible	MTC staff judgement	The effectiveness of this measure would be minimal because of the small percentage of travel that would be affected. The measure was thus dropped in the initial screening.

III. MEASURES TO ENCOURAGE ALTERNATIVE MODES OF TRAVEL

A. INCREASE TRANSIT RIDERSHIP

This set of measures would provide incentives for transit as an alternative transportation mode. For many commuters transit is a viable option, yet additional incentives need to be provided to induce significant diversion from the automobile. The following measures are designed to promote the transit mode.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
1. Additional Transit Service	Increasing transit service would increase its availability, decrease the waiting time and in some cases the running time, and generally make transit more competitive with the auto.	~ 0.7	*	Travel Model Analysis	A 20% increase in transit operating service would reduce 1985 daily emissions significantly. This measure is therefore recommended for implementation.
2. Fare Reductions	There are a number of variations of this measure. One is to simply reduce or eliminate transit fares. This would probably not be very effective, since the fares throughout the Bay Area are already relatively low. A second option is some form of a monthly pass. This has good potential since it would eliminate the psychological impediment of repeated payments, and so would encourage the diversion of casual trips to transit. A related option is the coordination of transfers between systems.	Negligible		Previous Studies and MTC staff	Because of the current low fare level, further reductions could conflict with regional policy and potentially state law. The monthly pass would probably not have significant air quality effects, but may be a desirable mechanism for encouraging transit ridership.
3. Improved Transit Comfort	This measure seeks to reduce the differences between the auto and transit modes by improving the comfort of transit service. This would be done by providing shelters at bus stops, better security, more comfortable buses, or other amenities.	Negligible		MTC staff judgement	It is believed that improved amenities alone would not significantly influence transit demand. Moreover, most of the existing transit development programs in the Bay Area will involve new, comfortable buses, additional bus shelters and radio communication. Thus, this measure was dropped from consideration in the initial screening.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
4. Bus and Carpool Lanes	Exclusive lanes for buses and carpools would be provided to give these vehicles a time advantage over single occupant autos. This measure is particularly effective at congestion bottlenecks. Experience in the Bay Area has shown that although the time saving is not large because the congested areas are short, buses have benefited since they are able to maintain more reliable schedules. Major examples of existing bus priority lanes in the Bay Area include Route 101 in Marin County, Route 280 in San Francisco, through the Bay Bridge Toll Plaza, and other points on freeways.	Bus Lanes Only	~ 0.1	Travel Model Analysis	Although these reductions are low, they could reinforce other measures, such as the additional transit service. Accordingly, they are recommended for implementation.
		Carpool Lanes Only	< 0.1		

B. ENCOURAGE THE PEDISTRIAN MODE

Provide Pedestrian Amenities

For short trips, walking is frequently the best alternative. Providing amenities such as wider pavements, or moving sidewalks between major activity centers can encourage people to walk for short trips.

Previous Studies and MTC staff judgement

A survey of previous studies indicated that, with the exception of auto-free zones, the provision of these amenities would not produce a significant shift from the auto. Rather, it is the dense land use pattern itself which generally encourages pedestrian activity. Since the auto-free zone was already included as a separate measure, we felt that the provision of these other amenities was not warranted from a strict air quality perspective.

C. ENCOURAGE THE BICYCLE MODE

Provide Bicycle Facilities

~ 2.0 *

MTC Parking Management Plan Study

One strategy that could be particularly effective is the greater use of bicycles for the short utility trip and interface with transit on the commute trip. During the summer and fall months, the weather is ideal for cycling, and the daylight is long enough to provide sufficient time for such trips. A comprehensive network of bike lanes would encourage bicycle use. The two major deterrents to the extensive use of bicycles have been safety and theft. The first, as statistics bear out, could be greatly mitigated through education acknowledging the bicycle as a legitimate mode and requiring similar knowledge and qualifications for its use as now is required for drivers of cars. Safe parking for bikes, particularly lockers at transit transfer points, shopping centers and other places, is possible with minimal capital outlay (\$175 per locker vs. about \$5,000 per parking stall or structure) and would do much to stimulate bicycle utility trips.

The effectiveness of this measure was estimated from previous work on Parking Management Plan for the Bay Area. Because this measure would affect all trips it has greater potential than many of the other measures which were aimed at the work trip only. We thus recommend implementation of this measure, to include both bike lanes and adequate storage facilities.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
D. MEASURES TO ENCOURAGE RIDE SHARING					
Carpooling has good potential as a strategy for reducing vehicle travel. It requires no new capital investment since the cars are already available. It can offer many amenities that transit cannot, such as door-to-door service. Finally, the cost savings are easily perceived by the individual riders.					
The following measures were considered.					
1. Toll Reduction for Carpools	One means of encouraging carpools is to reduce or eliminate the tolls on bridges or other toll facilities. Currently, the trans-bay bridges charge no tolls for carpools during peak hours. The Golden Gate Bridge also allows free passage of carpools.	Negligible		MTC staff judgment	Virtually all bridges now offer free passage to carpools during peak periods. Very little could be done to expand this measure, so it was eliminated during the screening process.
2. Preferential Parking for Carpools	Special lots would be reserved for carpools which would offer an advantage in location and/or price. Caltrans is currently leasing state lots in San Francisco which will be available to carpools for no more than \$10/month. Other fringe parking lots are being planned which will aid in carpool pickups.	~ 0.1	*	Travel Model Analysis	Since this measure will reinforce other carpooling measures, it is recommended for implementation.
3. Carpool Matching Information	These programs are oriented to providing assistance to those individuals interested in forming carpools. Caltrans currently administers a carpool matching program which seeks to match riders going to major employment centers. This could be expanded to include	~ 1.7	*	MTC staff judgment	A method of implementing this expanded scope through formation of a non-profit corporation is being considered. The effectiveness was estimated in conjunction with the following measure, vanpooling.

Table 13. Options Considered But Not Included in the Plan (Transportation Controls)

RECOMMENDATION	DESCRIPTION	EST. HYDROCARBON EMISSION REDUCTIONS (Tons/Day)		BASIS FOR ESTIMATE	COMMENTS AND SCREENING RATIONALE
		1985	2000		
	secondary employment centers and to solicit employer participation.				
4. Assist Vanpool Formation	Vanpooling has potential for replacing cars on the longer commute trips. The passengers pay the capital and operating costs of the van, and the driver is responsible for the operating and administrative aspects. A public entity can assist by matching interested participants, and by facilitating the purchase and insurance of the equipment.	1.7	*	MTC Staff Judgement	The same non-profit corporation is intended to encourage vanpooling by providing the stated services. The emissions reduction potential of this and the carpool matching program is significant. We therefore recommend both measures.

*The effectiveness of these measures was not estimated separately for the year 2000. They were combined with the compact development strategy for evaluation.

Section-6

CONTROL STRATEGY ANALYSIS

The effectiveness of alternative control strategies in improving air quality was analyzed by using a series of computer-based models. Given the wide variety of human activities causing air pollution, projections of future air quality improvements must account for changes in these activities and in future air pollution control technologies. The models used are simply means of quantifying the effects of such changes on future air quality.

The forecasting system consists of four components:

- The ABAG Series 3 population, housing, employment and land use modeling system.
- The MTC travel demand models.
- The ABAG vehicle emissions model.
- The Livermore Regional Air Quality Model (LIRAQ) maintained by the BAAPCD.

These models were used in three distinct applications. First they were used to project future air quality assuming a continuation of existing regional growth trends and existing control programs. The results of this "baseline" projection were previously described.

Second, using the baseline projections as a starting point, an emissions sensitivity analysis was conducted to determine the range of emissions levels necessary to meet the federal oxidant standard. The purpose of this exercise was to provide information on the design of control strategies to meet the standard.

Third, a series of strategy cases were developed from the alternative control measures and tested through the modeling system for their effectiveness in improving air quality.

DETERMINING THE RANGE OF EMISSION REDUCTIONS NECESSARY TO MEET THE OXIDANT STANDARD

To define the emission reductions needed to meet the oxidant standard, the baseline emission levels were systematically reduced and analyzed by the LIRAQ model. (The testing of such emission changes is sometimes referred to as sensitivity analysis.) Thus the model was applied in successive iterations using a number of differing hydrocarbon and NO_x emissions assumptions until the emissions levels which will result in attainment of the standard were found. Additional analysis and example LIRAQ maps produced as part of this analysis can be found in Appendix C.

Table 14 summarizes the results of the sensitivity analysis. Each column of the table corresponds to a different combination of percent reductions in hydrocarbon and NO_x emissions. The sensitivity analysis was conducted using the 1985 baseline emissions as the starting point, indicated in the first column with zero emission reductions. The expected worst case regionwide high hour oxidant level for each set of emission levels is shown in the last row.

From the table, it is apparent that in order to meet the .08 ppm Federal oxidant standard, more than a 40 percent reduction in regionwide hydrocarbon emissions is required in 1985. A closer examination of the results indicates that a 43% reduction in hydrocarbon emissions is required. This translates to an allowable level of hydrocarbon emissions of 450 tons per day to attain the federal oxidant standard.

A second conclusion apparent from the table is that reducing oxides of nitrogen emissions results in higher oxidant levels than what would occur with hydrocarbon emission reductions alone. Laboratory studies of oxidant formation and empirical evidence from Los Angeles and elsewhere indicate that nitric oxide reacts to temporarily suppress ozone formation--the ozone formation is delayed. This means that the level of nitrogen oxides plays an important role in determining where and when the maximum ozone formation will occur. Table 15 summarizes what is known and what is suspected in regard to the effects of further control of NO_x emissions in the Bay Area. The LIRAQ sensitivity analysis indicates that further NO_x control will result in higher oxidant levels within the region than would occur with a "hydrocarbon only" control strategy. On the other hand, by not controlling nitrogen oxides, it is suspected that the oxidant problem of the Bay Area may be transported to a neighboring airshed (e.g., Sacramento or Monterey). The implications to be drawn are that hydrocarbons should be stringently controlled and that care should be exercised in deciding how much control of oxides of nitrogen emissions is appropriate.

Table 14. LIRAQ Emission Sensitivity Analysis Results

% Reduction HC	0	20	40	60	80	40	80
% Reduction NO	0	0	0	0	0	20	40
Expected worst-case regionwide high hour ozone (ppm)	.19	.14	.08*	.07	.06	.11	.06

*This value was rounded off from an original value of .0846 ppm.

Assumptions: 1) 1985 Baseline Emission Inventory
2) July 26, 1973 Prototype Meteorology

TABLE 15. Summary of Oxides of Nitrogen (NO_x) Control Issue

THE IMPACTS OF ADDITIONAL NO _x CONTROLS		THE IMPACTS OF <u>NO</u> ADDITIONAL NO _x CONTROLS	
<u>OXIDANT AIR QUALITY</u>		<u>OXIDANT AIR QUALITY</u>	
<u>Within the Bay Area</u>	<u>Outside the Bay Area</u>	<u>Within the Bay Area</u>	<u>Outside the Bay Area</u>
LIRAQ analysis indicates that higher levels of oxidant occur with NO _x controls in the proposed comprehensive strategy.	It is <u>suspected</u> that downwind areas where transport may contribute to existing oxidant problems would be improved.	LIRAQ analysis indicates that lower levels of oxidant occur with <u>no</u> NO _x controls in the proposed comprehensive strategy.	It is <u>suspected</u> that downwind areas where transport may contribute to existing problems would experience <u>worse</u> oxidant air quality.
<u>NITROGEN DIOXIDE (NO₂) AIR QUALITY</u>		<u>NITROGEN DIOXIDE (NO₂) AIR QUALITY</u>	
<u>Within the Bay Area</u>	<u>Outside the Bay Area</u>	<u>Within the Bay Area</u>	<u>Outside the Bay Area</u>
May reduce NO ₂ violations if appropriate controls can be identified, e.g., stationary vs. mobile and ground level vs. elevated emissions.	Not of concern (no NO ₂ violations are recorded in neighboring air basins).	NO _x emissions are projected to be relatively constant between 1975-2000. However, the relative contributions from mobile sources and industry change substantially. NO ₂ violations may decrease as the motor vehicle NO _x emissions decrease by 2000.	Not of concern (no NO ₂ violations are recorded in neighboring air basins).

SUMMARY OF THE CONTROL STRATEGIES TESTED

Three control strategies were developed and tested with the modeling system. Each of these strategies were tested for their short term (1985) and long term (2000) effectiveness. The strategies are composed of alternative control measures considered to be the most effective and implementable. These strategies are summarized in Table 16.

Figure 19 summarizes how the land use, transportation, and technological emission controls were input to the modeling system previously described. From the inventory of alternative control measures, short and long term technological improvements were developed and their effects in reducing stationary and mobile source emissions computed. Similarly, the effects of land use and transportation control measures were analyzed directly by the ABAG and MTC models. These changes in the ABAG and MTC models were then translated into emission changes. Emission inventories were reconstructed based on the control measures and the resulting air quality projected by LIRAQ. The short and long term comprehensive strategies were evaluated by making appropriate modifications to each of the models in the system as shown.

The main results of the strategy analysis are summarized in Table 17. The table indicates that substantial improvements in air quality can be made through the use of technology. It also indicates that technology alone will not be sufficient to meet the .08 ppm Federal oxidant standard. The transportation and land use management strategy, although relatively ineffective in the short term, is shown to become increasingly effective with time. The primary value of the transportation and land use management strategy is that it helps in maintaining the air quality improvements achieved through the application of technology. Under the maximum technology strategy, air quality deteriorates significantly between 1985 and 2000 despite technological advances. The comprehensive strategy reduces this deterioration, but is still not enough to meet the Federal oxidant standard.

As previously discussed, the Federal oxidant standard is a one hour standard, not to be exceeded more than once per year. Table 17 indicates that if the Comprehensive Strategy is implemented, the number of times the standard would be exceeded drops to approximately 3 in 1985 and 11 in the year 2000. These estimates are necessarily approximate due to the natural variation in meteorological conditions from year to year. The California standard for oxidants, at .10 ppm for one hour, would be met in 1985 under the Comprehensive Strategy, but would be violated in the year 2000. Figures 20-26 are examples of LIRAQ results for each of the strategy cases summarized in Table 17.

An additional analysis was conducted to test the effects of the Comprehensive Strategy on the three northernmost counties in the region--Napa, Sonoma, and Solano. A comparison of expected oxidant levels on the LIRAQ prototype day in these counties is presented in Table 18 for both baseline conditions and under the Comprehensive Strategy. The table clearly shows a substantial improvement in oxidant levels will

Table 16 Summary of Control Strategies Tested

MAXIMUM TECHNOLOGY STRATEGY

- Use paints and other coatings that are water based and/or have a high solids content.
- Use closed systems for storage and transfer of organic liquids.
- Use best available control technology (BACT) on new and existing sources of hydrocarbon emissions.
- Adopt more stringent vehicle (light & heavy duty) exhaust emission standards.
- Implement mandatory annual inspection and maintenance program for light and heavy duty vehicles.
- Require exhaust control devices on existing heavy duty gasoline trucks.

TRANSPORTATION AND LAND USE
MANAGEMENT STRATEGY

- Increase tolls on bridges.
- Implement regional parking strategy to discourage private auto use and encourage high-occupancy auto use
 - parking tax
 - preferential parking for carpools, vanpools
- Provide additional transit service.
- Increase bus/carpool lanes and ramp metering.
- Implement an auto control zone in San Francisco central business district to reduce traffic.
- Provide more ride sharing services such as jitneys and vanpools.
- Develop more extensive bicycle systems.
- Achieve more compact development throughout the region by the year 2000.

COMPREHENSIVE STRATEGY

- By 1985, the comprehensive strategy includes: all of the technological control measures except for more stringent vehicle exhaust emission standards; and all of the land use/transportation measures. The effects of compact development were not included in the analysis for 1985 since the short time frame was insufficient for achieving significant results.
- By 2000, the comprehensive strategy includes: all of the technological control measures except for the exhaust control devices on existing heavy duty gasoline trucks (this measure provides short term benefits only); and all of the land use/transportation measures.

Figure 19

Control strategy testing with the AQMP Modeling System

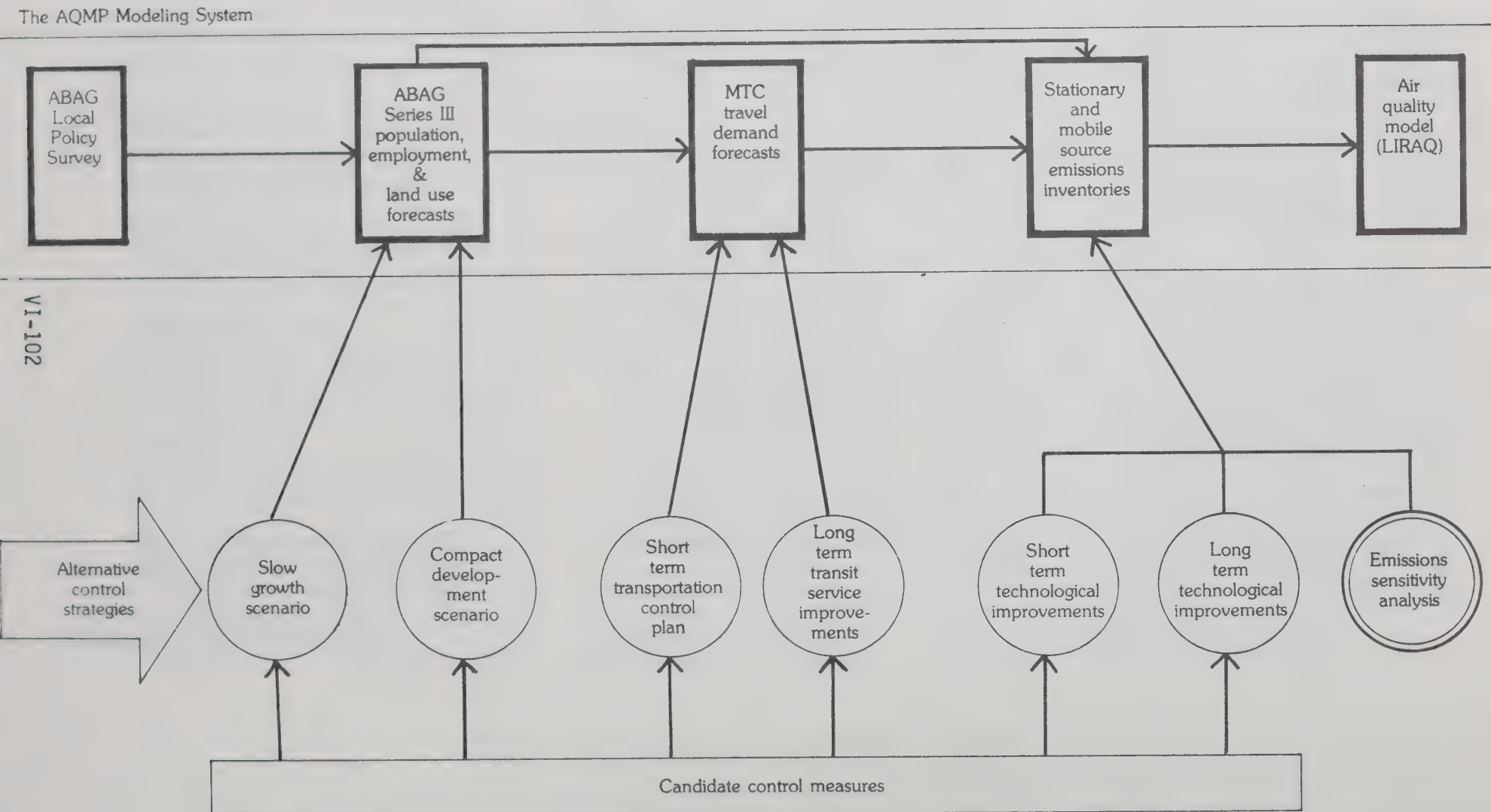


Table 17 Effectiveness of Alternative Control Strategies

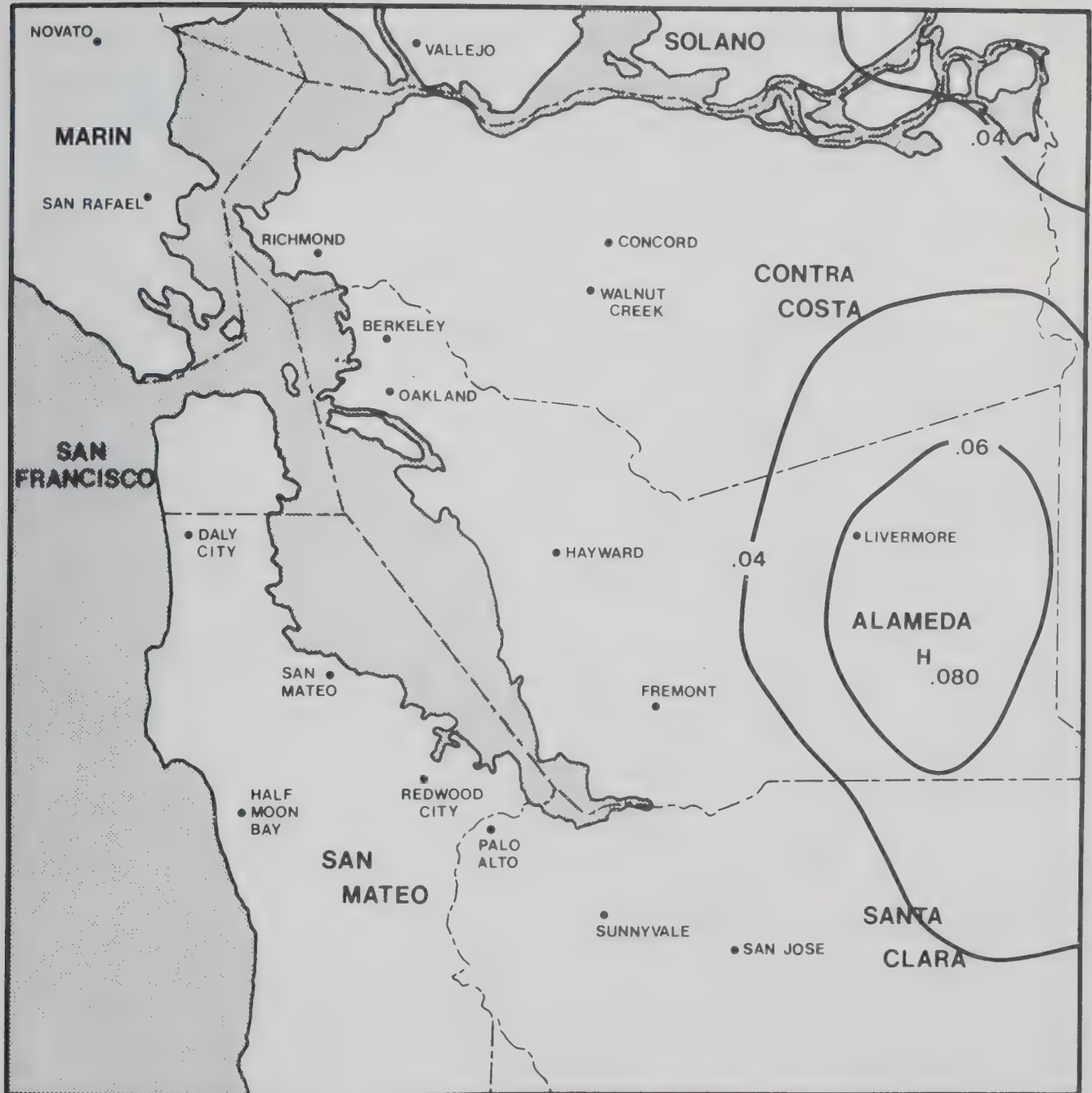
Strategy	1985			2000		
	Hydrocarbon Emission Reduction Potential	Estimated Regionwide High Hour Oxidant Level (ppm)	Estimated No. of Annual Violations of the 1-Hour .08 ppm Federal Oxidant Standard	Hydrocarbon Emission Reduction Potential	Estimated Regionwide High Hour Oxidant Level (ppm)	Estimated No. of Annual Violations of the 1-Hour .08 ppm Federal Oxidant Standard
Baseline (do-nothing)*	(797 tons/day) emitted	.19ppm	130	(1,058 tons/day) emitted	.24ppm	275 hours
Maximum Technology	- 280 tons/day	.10ppm	3	- 441 tons/day	.13ppm	16 hours
Transportation and Land Use Management	- 7 tons/day	not estimated	-	- 84 tons/day with slow growth	.23ppm	220 hours
Comprehensive Strategy*	- 286 tons/day	.10ppm	3	- 513 tons/day with slow growth	.12ppm	11 hours

*Does not assume New Source Review Regulation.

Table 18. LIRAQ Baseline and Comprehensive Strategy
Analysis for the North Bay (2000)

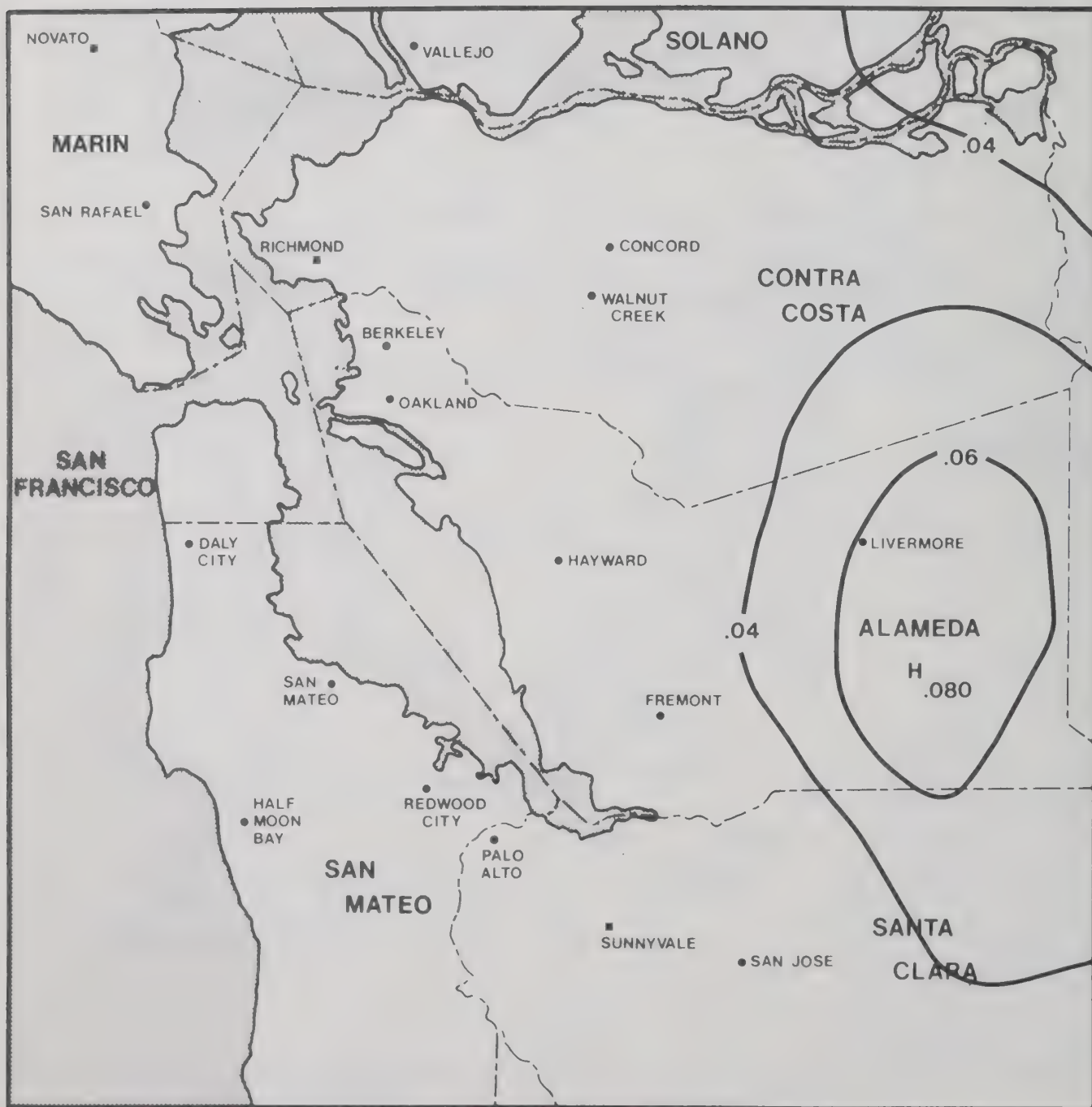
	<u>Baseline</u>	<u>Comprehensive Strategy</u>
Location of North Regional High Hour Ozone	12 km. ESE Travis AFB	14 km. ESE Travis AFB
North Regional High Hour (ppm)	.08	.06
Monitoring Station with Highest Ozone	Napa Airport	Travis AFB
Ozone at Highest Station (ppm)	.07	.06
<u>Projected Ozone Maximum at Individual Stations (ppm)</u>		
San Francisco	.02	.02
Santa Rosa	.04	.04
San Rafael	.03	.03
Petaluma	.04	.03
Napa	.07	.05
Sonoma County Airport	.03	.03
Pittsburg	.05	.05
Hamilton Air Force Base	.03	.03
Napa County Airport	.07	.05
Concord	.06	.04
Richmond	.04	.03
Travis Air Force Base	.07	.06
Angel Island	.04	.03
Point Bonita	.04	.03
Fairfield	.06	.05

Figure 20. Example LIRAQ Results- 1985 Control Strategy Analysis
(Maximum Technological Improvements Only)



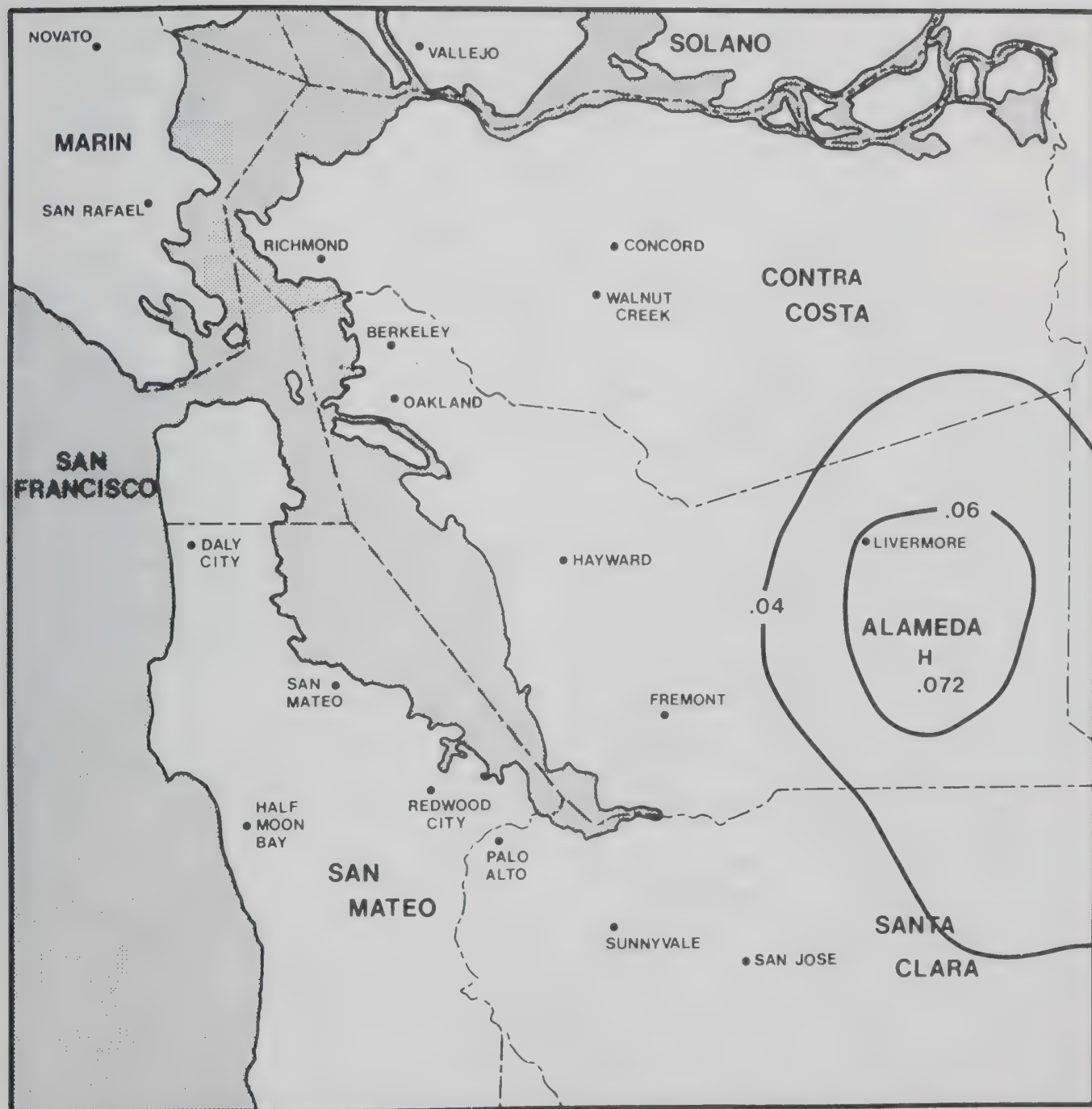
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 1985 baseline inventory

Figure 21. Example LIRAQ Results - 1985 Control Strategy Analysis
(Comprehensive Strategy including Additional NO_x Controls)



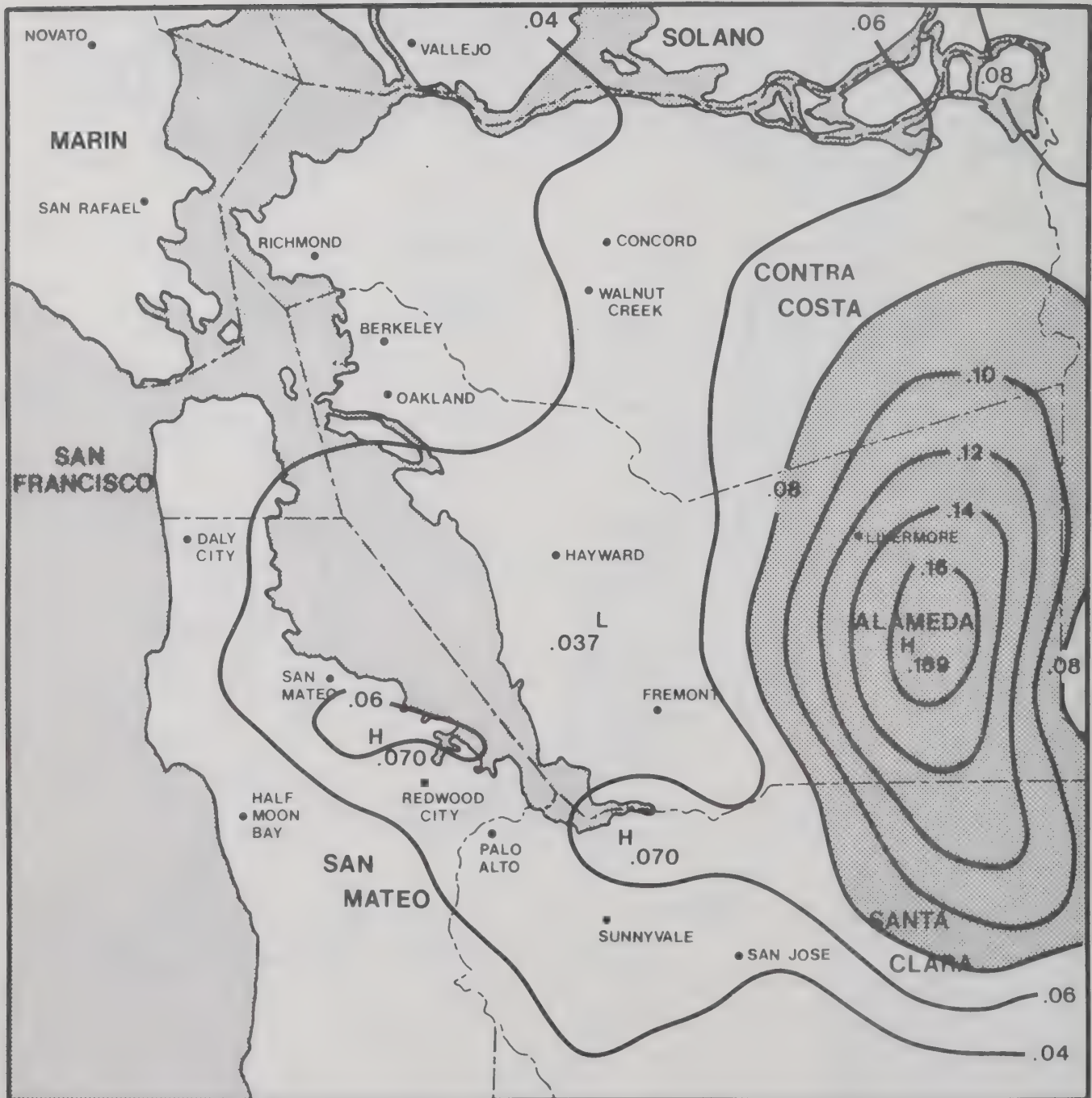
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 1985 baseline inventory

Figure 22. Example LIRAQ Results - 1985 Control Strategy Analysis
(Comprehensive Strategy without Additional NO_x Controls)



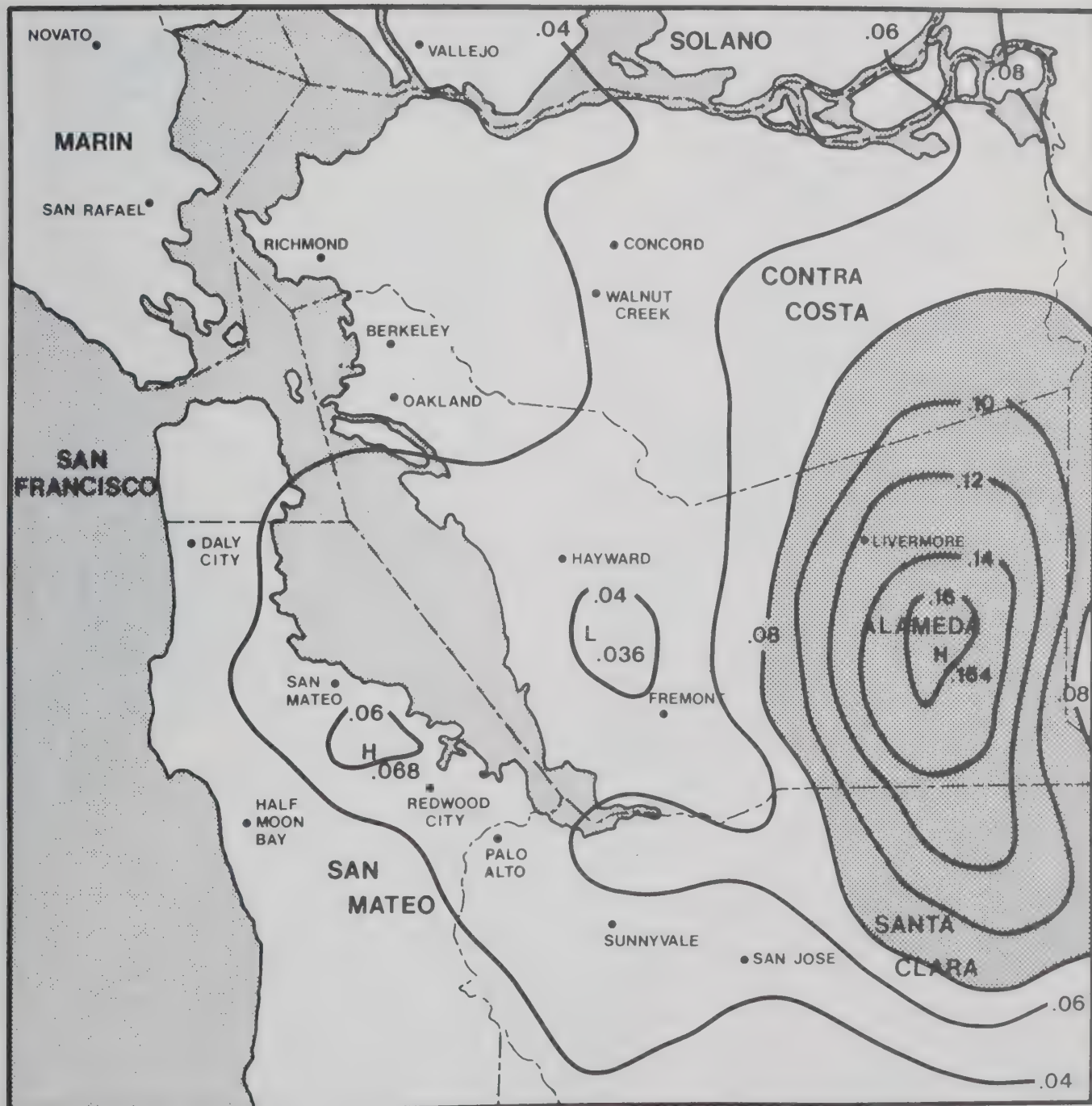
- Notes:
- 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 - 2) Values uncorrected for worst case conditions
 - 3) Emission reductions taken from 1985 inventory

Figure 23. Example LIRAQ Results - 2000 Control Strategy Analysis
(Baseline Projection Assuming Slower Population Growth Rate)



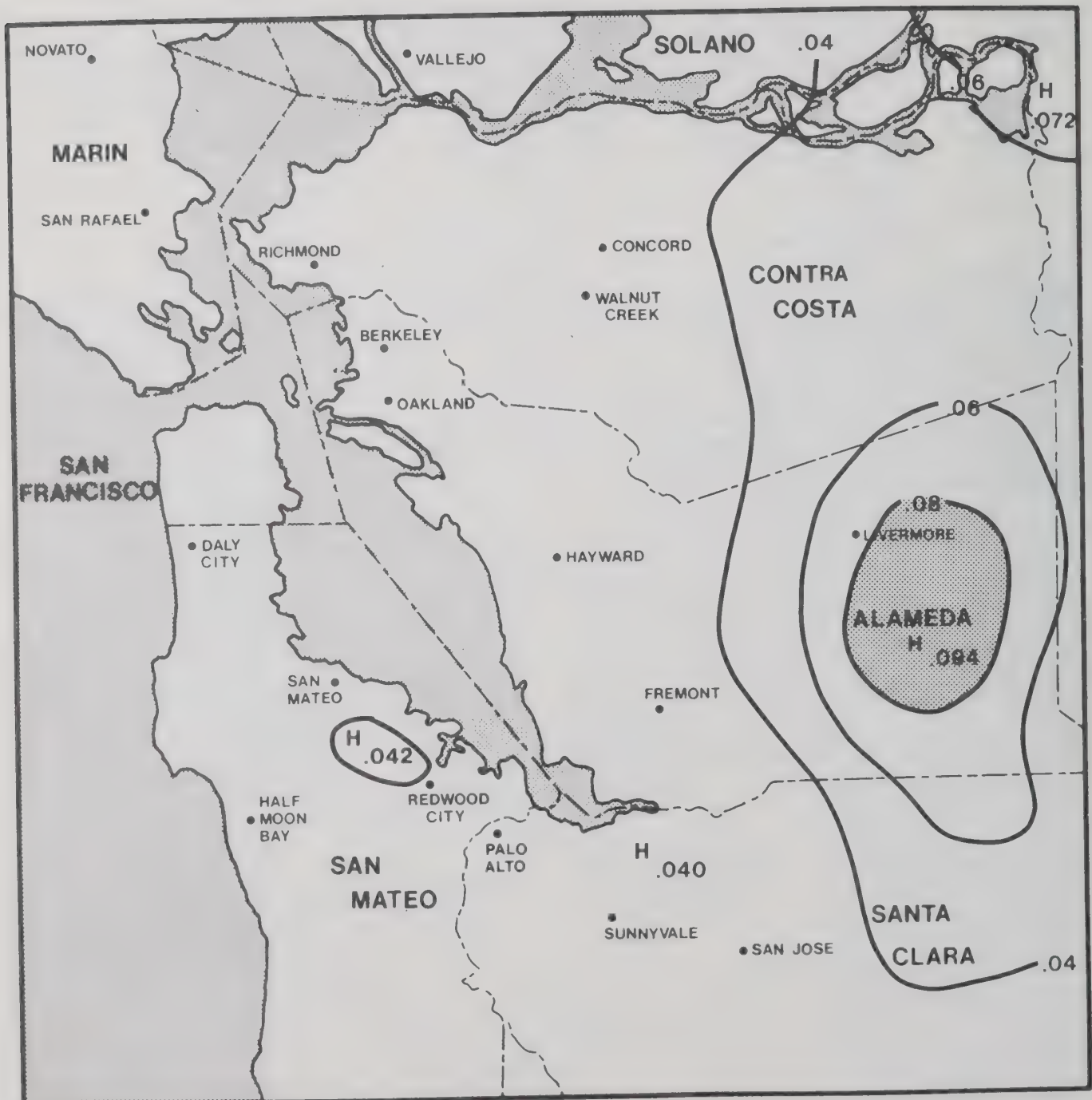
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 2000 baseline inventory

Figure 24. Example LIRAQ Results - 2000 Control Strategy Analysis
(Transportation Controls and Land Use Management Only)



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 2000 baseline inventory

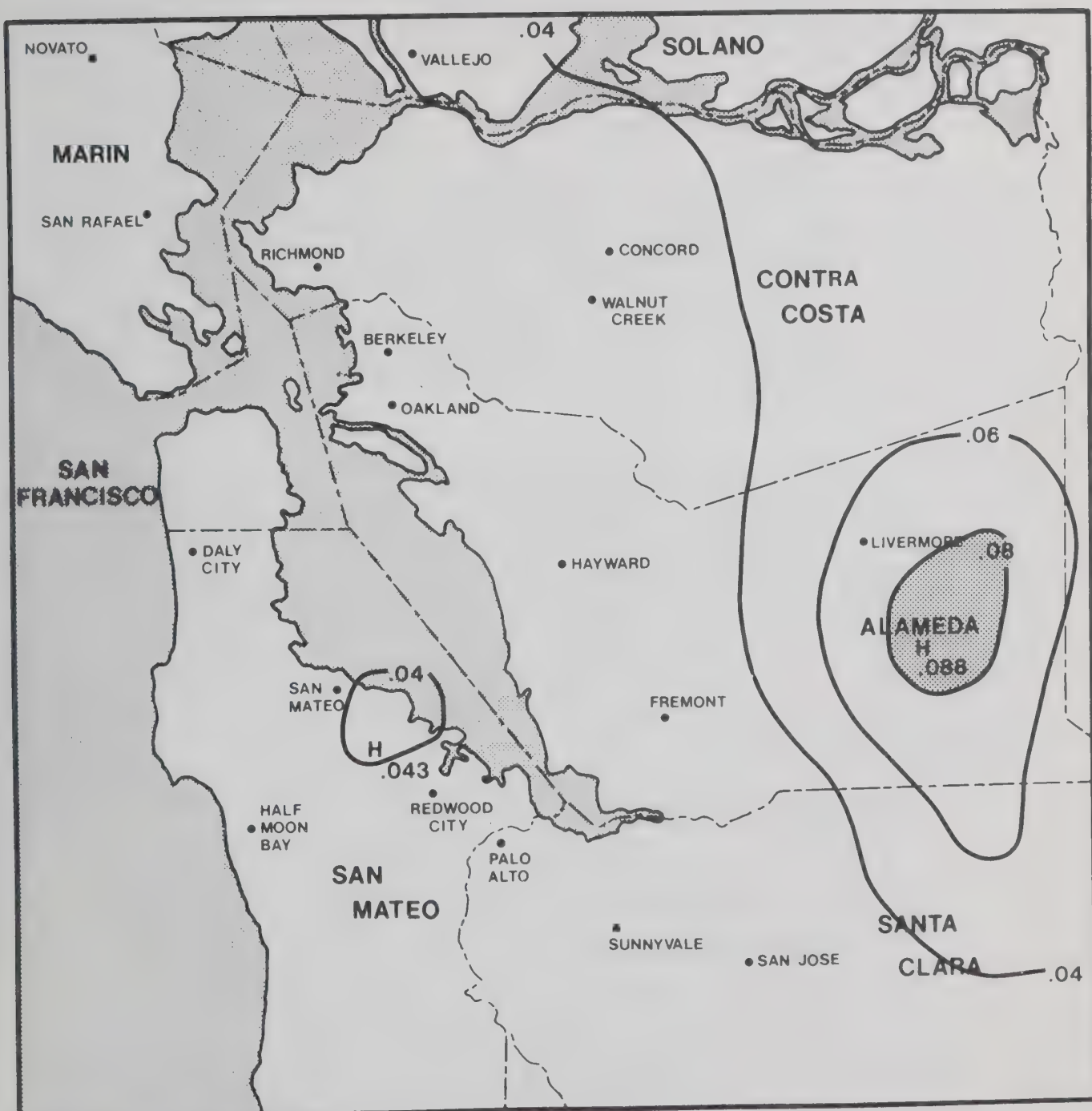
Figure 25. Example LIRAQ Results - 2000 Control Strategy Analysis
(Maximum Technological Controls Only)



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 2000 baseline inventory

Figure 26. Example LIRAQ Results - 2000 Control Strategy Analysis

(Comprehensive Strategy without Additional NO_x Controls)



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 2000 baseline inventory

occur in these northern counties under the Comprehensive Strategy. Based on the worst case estimates and number of expected violations for the region previously summarized in Table 17, it is expected that the oxidant standard will also be met in the northern counties under the Comprehensive Strategy.

MEETING THE .08 PPM OXIDANT STANDARD

The amount of hydrocarbon emissions allowable for the Bay Area to meet the oxidant standard is variable and influenced by a number of factors. As previously noted, the level of nitrogen oxides present strongly influences peak oxidant formation. Similarly, the spatial and temporal distribution of emissions is important. Based on the best information available, hydrocarbon emissions of less than 450 tons per day are required to meet the 0.08 ppm oxidant standard. In some instances, depending on nitrogen oxides present and how the hydrocarbons are distributed, substantially less hydrocarbon emissions would be needed in order to meet the standard.

The additional reductions in hydrocarbon emissions required to meet the oxidant standard in 1985 and 2000 are summarized in Table 20. By comparing the hydrocarbon emissions remaining after implementation of the Comprehensive Strategy to the allowable emissions level, the additional increments of emission reduction necessary to meet the standard may be estimated as shown in the table. Two estimates are given for the year 2000 to indicate the range of the additional reductions required depending on the population level reached in the region at that time.

Three alternatives have been identified for designing a strategy to meet the .08ppm oxidant standard:

- 1) Implement additional, less cost-effective controls on existing hydrocarbon sources.
- 2) Enforce restrictions on the growth of new sources and indirect sources of hydrocarbon emissions in the region.
- 3) Some combination of 1 and 2.

Table 19. Hydrocarbon Emission Reductions Required to Achieve the 0.08 PPM Photochemical Oxidant Standard

	<u>1985 (Tons/Day)</u>	<u>2000 (Tons/Day)</u>	
Base Line Emissions	797	1058	
Allowable Hydrocarbon Emissions ^a	<450	<450	
Hydrocarbons Remaining After Implementing Comprehensive Strategy	511	604 ^b	545 ^c
Additional Hydrocarbon Reductions Needed to Meet Standard	>61	>154 ^b	>95 ^c

^aVaries as a function of oxides of nitrogen emissions and the spatial and temporal distribution of all precursor emissions.

^bAssumes upper range of population forecast in Series 3 projections--6.1 million people in 2000.

^cAssumes lower range of population forecast in Series 3 projections-- 5.4 million people in 2000.

Additional Controls on Existing Sources

Table 20 summarizes additional control measures which could be applied to provide the final increment of control necessary to achieve the standard. These measures have not been analyzed to the same level of detail as the measures in the Comprehensive Strategy.

Table 20. Additional AQMP Control Measures for Existing Sources and Approximate Emission Reduction Potentials^a

	1985		2000	
	T/D	(%)	T/D	(%)
<u>Stationary Sources</u>				
● Lower Reid Vapor Pressure	15-30	2-4	20-35	2-3
● Ban Small Gasoline Engines (e.g., Lawnmowers)	10-15	1-2	20-30	2-3
<u>Mobile Sources</u>				
● Catalytic Converter Retrofit ('71-'74 LDV)	6	0.6	0	0
● Evaporative Retrofit (pre-1978)	4	0.4	0	0
<u>Transportation Controls</u>				
● Increased Gas Tax				
● Area License				
● Smog Charges				
● More Stringent Application of Previously-cited Transportation Controls	3-5	0.3-0.6	To be implemented with land use management measures	
<u>Other</u>				
● Gasoline Rationing	Variable impact depending on stringency of application and user groups affected. (A 100% rationing program could yield an additional 170 ton/day emission reduction by the year 2000.) Obviously, a very direct and potentially effective means of reducing hydrocarbon emissions.			
● Prohibiting Certain Organic Solvent Use	Variable impact depending on stringency of application. (A 100% prohibition could yield an additional 160 ton per day emission reduction by the year 2000.) This measure assumes going considerably beyond the use of water-based and high solids content solvents and BACT on organic solvent evaporation.			

^aAssumes prior implementation of the Comprehensive Strategy.

The lowered Reid Vapor Pressure of gasoline would produce the undesirable side effect of making vehicle engines difficult to operate in cold weather. If only small changes in vapor pressure are required, engine start-up and warm-up problems are minimal but the corresponding effectiveness of this measure is also minimal. This program has been studied in the past on a number of occasions. A current study being conducted by the American Petroleum Institute has concluded this proposal has very limited potential as an air pollution control measure. The technical feasibility of this measure is questionable. Therefore, it does not appear to be an attractive option for the AQMP.

A ban on the use and/or sale of gasoline engines would include lawnmowers, chain saws, small gasoline powered pumps and generators, etc. In some cases alternatives can be found such as electric lawn mowers; however, these alternatives have other undesirable characteristics in terms of inconvenience (small gasoline engines are ideal for use in situations where electrical power is not conveniently available). Enforcement of this measure could be difficult. This measure has many very obvious administrative and implementation obstacles associated with it. It is not considered to be an attractive option for the AQMP.

The catalyst and evaporative retrofit measures for light duty vehicles are marginally effective by 1985 and decrease in effectiveness as the retrofitted vehicles age and are eventually junked. Previous retrofit programs attempted by the California Air Resources Board have been unpopular, since there are no direct benefits to the vehicle owner. These programs have a very short term benefit and require rapid adoption and implementation to achieve their greatest potential. Given the many technical problems associated with retrofit programs in the past, these control measures are not considered to be attractive option for the AQMP.

The transportation controls listed can yield emission reductions shown if stringently applied. For example, a 300% increase in the cost of gasoline via a gasoline tax would yield an approximate 1 to 2 tons/day hydrocarbon emission reduction in 1985. A close assessment of any particular proposals is recommended prior to inclusion in the plan.

The measures listed as "other" can yield a range of emission reductions depending on how stringently they are applied. A 100% gasoline rationing program would yield an additional emission reduction of about 170 tons/day by the year 2000, assuming prior implementation of the Comprehensive Strategy. A 100% prohibition on organic solvent use in the region could yield an additional emission reduction of about 160 tons/day beyond the Comprehensive Strategy. The effectiveness of intermediate levels of stringency are difficult to estimate, but are expected to be somewhat less than proportional. The impacts of these measures are also variable depending on the stringency of their application. Again, because of the very obvious problems associated with implementing these measures, they do not appear to be attractive options for the plan.

Management of the Growth of New Sources and Indirect Sources

An alternative to additional control over existing sources is to manage the growth of new sources and indirect sources of emissions. New Source

Review (NSR) was excluded from the air quality evaluation of the Comprehensive Strategy for a number of reasons:

- NSR is of variable effectiveness, depending on how stringent the adopted rule is (e.g., off-set provisions).
- The specific form of NSR appropriate and acceptable to regional, State, and Federal regulatory agencies has been and continues to be debated.
- It is more appropriate to compare the effectiveness of NSR with respect to other control programs using a common baseline forecast. Such a forecast should not already include an NSR assumption.

In considering alternatives for attaining and maintaining the oxidant standard after all reasonably available controls have been implemented, NSR is of interest. Its effectiveness can range from zero to a maximum of approximately 200 tons/day reduced by the year 2000. The specific level of effectiveness achieved depends on the number and type of sources subject to review, and the specific review criteria used for determining compliance.

Indirect Source Review (ISR) is the counterpart to New Source Review for sources which do not directly emit pollutants, but which cause or induce emissions from other sources. Shopping centers, parking lots, and airports are examples of indirect sources of pollution. The land use management recommendations in the Comprehensive Strategy would rely heavily on implementation by local governments, with no real mechanisms for ensuring consistent implementation from one jurisdiction to another across the region. An Indirect Source Review program conducted at the regional level would provide the necessary mechanism. The Bay Area Air Pollution Control District has the legal authority to implement such a program. With specific technical assistance from the Metropolitan Transportation Commission and the Association of Bay Area Governments, the BAAPCD could administer an ISR program for the region.

New Source Review and Indirect Source Review can ensure sufficient hydrocarbon emission reduction to allow attainment of the oxidant standard and continued maintenance thereafter. In addition, NSR and ISR regulations are such that they can provide some degree of flexibility. Initially strict regulations can be changed and relaxed somewhat after it has been demonstrated that the air quality standards can be attained and maintained in spite of such relaxation.

The role of the NSR/ISR programs in relation to the Comprehensive Strategy and baseline air quality is illustrated in Figure 27. The Comprehensive strategy is shown to provide the bulk of the air quality improvement between now and the year 2000, while the role of the NSR/ISR programs would be to provide the incremental emission reduction (or prevention) necessary to attain and maintain the federal oxidant standard. As the Comprehensive Strategy is made more stringent, restrictions on new source development can be made less stringent, and vice versa.

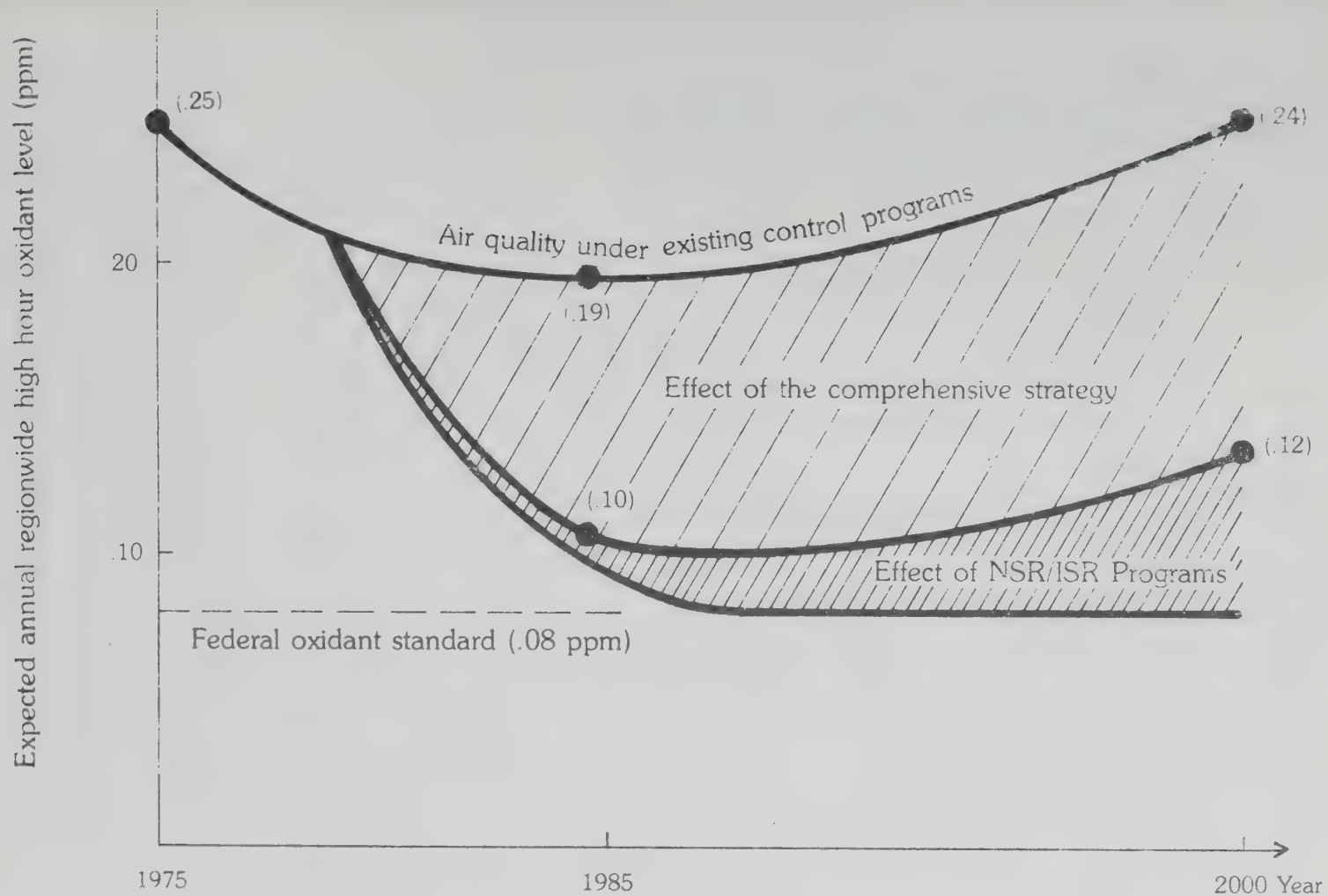


Figure-27

Relative roles of new source review/indirect source review programs and the comprehensive strategy in achieving and maintaining the Federal oxidant standard in the San Francisco Bay Region.

Section-7

PLAN RECOMMENDATIONS

The draft air quality maintenance plan is comprehensive, recommending a broad range of control programs for photochemical oxidants. It includes more controls on stationary sources of air pollutants and on motor vehicles. It also includes proposals for changes in the region's transportation systems and for management of development to achieve compact growth.

The recommended application of improved technological controls to stationary sources and motor vehicles would produce the most substantial improvements in air quality. The transportation and development measures would act together to reduce automobile traffic, a major source of air pollutant emissions. The stationary and mobile source controls, together with transportation and development measures and new and indirect source review programs, would ensure eventual attainment and long-term maintenance of the Federal oxidant standard.

In addition to other requirements, an acceptable air quality plan must demonstrate numerically that the oxidant standard would be achieved and maintained. The Environmental Management Task Force directed the staff to prepare such a plan, and to present options to measures in that plan. Approximately 100 measures were analyzed for their effectiveness in reducing emissions. The recommended plan is described in this section. Options for measures in the plan are described in Section 5. At the end of this section, a procedure is described for modifying the plan.

The recommended plan is diverse and flexible. The diversity is an advantage because it reduces the reliance on a single type of control. The plan is flexible because the new and indirect source review programs can be applied with varying degrees of stringency as appropriate to meet the standard. Flexibility is desirable to accommodate uncertainty. In Section 4, uncertainties relating to forecasting and the analytical tools used for the preparation of the air quality plan are discussed. There are also uncertainties in estimating the effectiveness and costs of control programs that have not yet been implemented, and for which only limited information and experience are available.

The development and transportation actions would be implemented by local governments and would demonstrate good faith efforts to meet and attain the oxidant standard as expeditiously as practicable. It is quite clear that the partnership of Federal-State-regional-local efforts called for by this plan to improve air quality would demonstrate reasonable progress toward attainment and could qualify the region for a five-year extension in meeting the Federal standard.

RECOMMENDATIONS

The plan recommendations are summarized in Table 21. For each action listed in the first column, subsequent columns of the table indicate the agencies responsible for implementing the action, the implementation schedule, costs, sources of financing, direct benefits in terms of emission reductions, and other environmental, institutional/financial, economic, and social impacts of the action.

Figure 28 highlights in graphic form the schedule for implementation of each of the plan recommendations. Most of the recommendations could be adopted by appropriate agencies within two years of plan approval. However, full implementation would realistically require several years beyond the adoption phase, particularly for the most significant programs such as the use of best available control technology (BACT). It is therefore unlikely that the oxidant standard can be met in the Bay Area by 1982. The ultimate 1987 target year for attainment set by the 1977 Clean Air Act Amendments can be met through implementation of this plan.

The following narrative provides background information for the recommended actions.

I. General Policy: Minimize Hydrocarbon Emissions from Stationary Sources

The actions necessary to implement this policy must focus on both existing and future sources of hydrocarbon emissions in the Bay Area. Heavy reliance is placed on requiring the use of advanced emission control technology for existing sources. New sources of emissions will face stringent review requirements before being allowed to locate in the region.

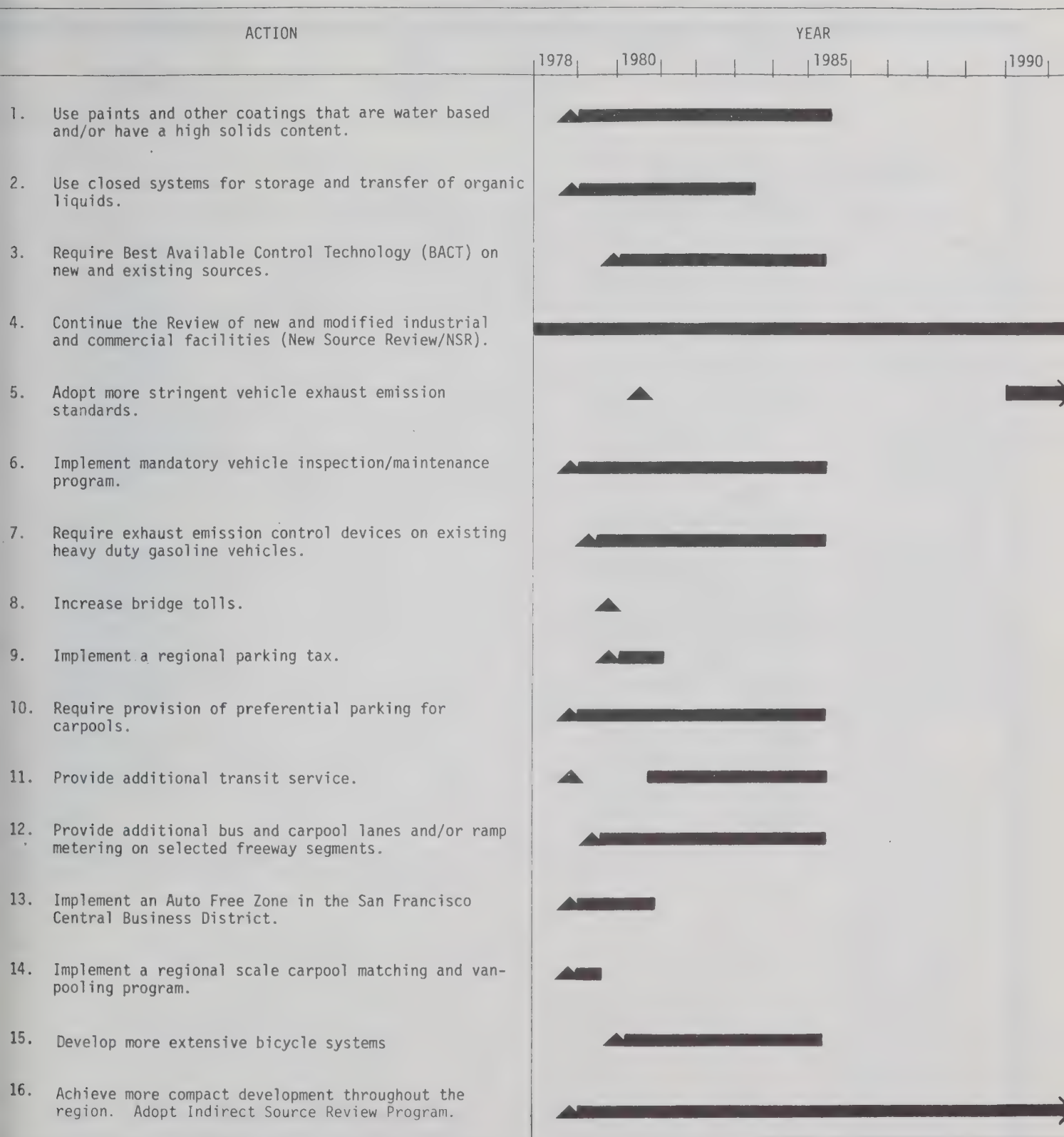
Action 1: Use paints and other coatings that are water based and/or have a high solids content.

Surface coating operations, e.g., architectural and industrial painting, constitute a major source of hydrocarbon emissions to the atmosphere. Without further controls, coating operations projected to 1985 would emit 140 of a total of 570 tons per day of hydrocarbons from stationary sources. Hydrocarbons result from evaporation of the solvents and thinners in paints and coatings used to provide a variety of properties such as consistency, settling rate, drying time and flow over the surface. Architectural coatings are defined as those used on structures, interior and exterior, such as buildings, fences, bridges, etc. Industrial coatings are those applied in production of auto bodies, cans, fabrics, toys, etc.

Two types of control measures have been in effect for several years. The first limits the use of highly photochemically reactive organic chemicals in solvents, substituting less reactive chemicals. These reformulated solvents are less reactive than formerly, but are still photochemically reactive. The second, used in industrial coating operations where the solvent emissions can be contained and channeled, incinerates the emissions - analogous to afterburners on automobiles - or adsorbs emissions on activated charcoal for subsequent recovery.

The proposed measure is aimed at reducing the amount of organic solvent evaporation from surface coating operations by reducing the content of organic solvent in the coating as applied - perhaps more properly, by reducing the

FIGURE 28. SCHEDULE FOR IMPLEMENTATION OF THE AIR QUALITY MAINTENANCE PLAN



▲ adopt program/regulation

■ implementation

Air Quality Maintenance Plan recommendations

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000		IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
I. Stationary source controls							
GENERAL POLICY: MINIMIZE HYDROCARBON EMISSIONS FROM STATIONARY SOURCES							
Action 1 Use paints and other coatings that are water based and/or have a high solids content.	60	80	Bay Area Air Pollution Control District (BAAPCD)	A - 1978 to 1980 I - 1985	\$7,170,000 ^b	Administrative/ Regulatory - Ad valorem tax revenues - ARB subvention Funds - Federal Clean Air Act funds	BAAPCD Enabling Legislation
Action 2 Use closed systems for storage and transfer of organic liquids.	40	65	BAAPCD	A - 1978 I - 1983	\$17,000,000 ^b	Operating/ Maintenance - Private	BAAPCD Enabling Legislation
Action 3 Use best available control technology (BACT) on new and existing hydrocarbon sources.	227	339	BAAPCD	A - 1980 I - 1985	\$529,000 ^a \$29,331,000 ^b	Capital - Private - California Pollution Control Financing Authority - Federal Small Business Administration Loan Programs	BAAPCD Enabling Legislation
<div>PROCESS<div>TECHNOLOGY</div></div> <div>Organic storage.....Dual & parallel vapor recovery Tar pots.....Loading door assembly Paint spray booth.....Incinerator or low/no solvent coatings Architectural coating.....Low solvent coatings Dry cleaning.....Closed system with solvent recovery Chemical milling, plating.....Fume scrubbers (packed bed) Cable tar coating.....Incineration Gasoline bulk storage.....Floating roof or fixed roof & vapor recovery Auto service station storage tanks.....Closed balanced system with secondary system Auto fill operations.....Secondary vacuum assist system</div>							
Action 4 Continue the review of new & modified industrial and commercial facilities (new source review)	Variable, depending on the stringency of application. Maximum effect of 64 tons/day of hydrocarbon emissions reduced in 1985 and 200 tons/day in 2000.		BAAPCD	Currently being implemented	No direct costs		BAAPCD Enabling Legislation
<div><div>^a Public agency</div><div>^b Private</div></div>							

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS
<u>Air Quality</u> <ul style="list-style-type: none"> o See "Direct Benefits" column. 	<u>Institutional</u> <ul style="list-style-type: none"> o The governmental structure for implementing these control measures already exists in the Bay Area Air Pollution Control District which actively enforces air pollution control programs in the Bay Area. The measures being proposed for consideration here are simply more stringent extensions of measures already in force for control of industrial and stationary sources of air pollution. 	<u>Production of Goods and Services</u> <ul style="list-style-type: none"> o Increased technological dependence by the Bay Area industrial sector to improve regional air quality will require considerable capital investment. In some instances, these added restrictions and costs may adversely affect the competitive position of local industries inter-regionally where the cost of these investments may be passed on to the consumers. o Measures pertaining to coatings will require that process changes occur in order to reduce levels of air pollution. Changed product composition resulting from different processes could result in reduced durability and therefore increased product liability potential for the coatings industry. Phased implementation of this program should help minimize these problems. 	<u>Housing Supply</u> <ul style="list-style-type: none"> o No impact.
<u>Water Quality</u> <ul style="list-style-type: none"> o No impacts. 	<u>Financial</u> <p>Direct Public Costs of Implementation</p> <ul style="list-style-type: none"> o See public costs (a) in the column headed "Total Cost/Yr. of Recommended Action." <p>Fiscal Effects on Local Governments</p> <ul style="list-style-type: none"> o The BAAPCD operating funds are obtained from local property taxes and State and Federal grants. Exactly how the costs will be apportioned is presently unclear; however, no direct costs to local governments are expected 	<u>Income and Investment</u> <ul style="list-style-type: none"> o See Private Costs (b) in the column headed "Total Cost/Yr of Recommended Action." 	<u>Physical Mobility</u> <ul style="list-style-type: none"> o No impact.
<u>Physical Resources</u> <ul style="list-style-type: none"> o Between 18,000 and 25,000 gallons per day of organic solvents could be conserved from proposed organic solvent controls. o Best available control technology would consume construction materials, water, disposal facilities, etc. However, it does comprise many things and has not been identified with regard to Bay Area industrial operations. Consequently, more detailed assessments will require further definition of BACT. 		<u>Consumer Expenditures</u> <ul style="list-style-type: none"> o While the direct costs of implementing these measures will initially fall upon industry, many, if not all of them will find their way to the consumer and local taxpayer. Since supporting this type of activity is not the type of expense to result in increased productivity or in direct economic return for most of them, it may be considered an inflationary cost. In addition, higher prices for Bay Area products reflecting this cost may become less attractive to non-Bay Area consumers who may look elsewhere for the same product. On the other hand, consumers and local taxpayers may view the costs of implementation as an investment having non-economic but equally valuable return. In either case, implementation of the proposed control measures is likely to result in an increased cost of consumer goods. 	<u>Health and Safety</u> <ul style="list-style-type: none"> o Air quality standards for each of the pollutants are based upon scientifically derived air quality criteria. Air quality criteria are an expression of current information concerning the relationship between various concentrations of pollutants in the air and their adverse effects on man and his environment. The control measures being proposed are designed to meet the standards, i.e., to reduce the concentration of various pollutants in the air. Pollutant concentration reductions from the air will reduce potentially adverse effects from these substances, thereby favorably impacting public health. o With regard to safety, the stationary source control program may eliminate many hazards associated with the use and storage of combustible solvents.
<u>Energy Resources</u> <ul style="list-style-type: none"> o Use of best available control technology for hydrocarbon emissions (including the use of high solids/water base coatings and closed systems for organic liquid storage) should not result in a net energy penalty. Certain technologies such as industrial water based coatings and solvent incineration involve energy penalties, while other technologies such as high solids coatings and improved vapor recovery systems produce energy savings. o Current new source review activities could be perpetuating excessive energy use by old and inefficient plant operations that are presently unable or unwilling to meet stringent NSR requirements in order to modernize. 			<u>Sense of Community</u> <ul style="list-style-type: none"> o No impact.
<u>Amenities</u> <ul style="list-style-type: none"> o The principal impact of the stationary source actions would be their contribution toward the improvement of air quality in the Bay Area. 			<u>Equity</u> <ul style="list-style-type: none"> o A major question of equity involves the competitive position of Bay Area industries that are placed under the restrictions and controls proposed by the stationary source measures. This question can be extended to employment opportunities for the local population. Some employment and business opportunities will be created in local industries producing air pollution control equipment. However, whether or not those opportunities will be available or sufficient to offset increased unemployment resulting from competitive disadvantage (see "Production of Goods and Services") is an issue requiring further exploration. The willingness of the U. S. Environmental Protection Agency and the California Air Resources Board to require similar measures outside of the Bay Area is of obvious concern to the region.

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
II. Mobile source controls						
GENERAL POLICY: MINIMIZE HYDROCARBON EMISSIONS FROM MOTOR VEHICLES						
Action 5 Implement more stringent vehicle (light duty and heavy duty) exhaust emission controls--approx. 50% reduction below 1977 prescribed levels.	- 62	California Air Resources Board (CARB)	A - 1980 I - 1990	\$3,000 ^a \$24,910,000 ^b	- Private	Mulford- Carrell Air Resources Act
Action 6 Implement inspection/ maintenance program for light and heavy duty vehicles.	23 58	CARB and/or Bureau of Automotive Repair	A - 1978 I - 1985	\$1,395,000 ^a \$16,892,000 ^b	- I/M Program revenues - State General Fund	New Legislation Required
Action 7 Require heavy duty gasoline exhaust control devices on existing vehicles.	25 -	CARB	A - 1979 I - 1985	\$8,000 ^a \$1,534,000 ^b	- Private	New Legislation Required

^a Public agency^b Private

ENVIRONMENTAL IMPACTS

INSTITUTIONAL/FINANCIAL IMPACTS

ECONOMIC IMPACTS

SOCIAL IMPACTS

Air Quality

- o See "Direct Benefits" column.

Water Quality

- o No impact.

Physical Resources

- o No significant impact on physical resources is expected from more stringent exhaust emission controls where such can be achieved by further technological improvement of conventional vehicle engines. However, if new engine designs requiring alternative fuel sources are pursued to achieve this measure, then new materials may be required to manufacture these engines. (For example, electrically-powered vehicles may require special material to construct batteries capable of providing satisfactory power performance.) Of greater significance is the possibility that new engine technologies will utilize less specialized fuels, thereby reducing dependence on gasoline or petroleum per se.

Energy Resources

- o Mobile source emissions controls will produce significant energy savings through improved maintenance of engines and emission control systems, as well as through the eventual development of new engine technologies. The inspection and maintenance program and the retrofit program for heavy duty gasoline trucks could save approximately 10,000,000 gallons of gasoline per year, or about 240,000 barrels of oil per year. New engine technologies could eventually produce as much as 50 percent improvement in vehicle mileage, which in turn would mean annual energy savings of millions of barrels of oil.

Institutional

- o The governmental structure for implementing mobile source control measures already exists in the California Air Resources Board (CARB) which presently has primary responsibility for controlling vehicular emissions in the State. However, specific institutional arrangements for implementing both the inspection/maintenance programs and the heavy duty gasoline retrofit program will be required since none of them are within the current authority of CARB.

The California Air Resources Board and/or the Bureau of Automotive Repair (BAR) would likely assume responsibility for the regulation and operation of I/M programs. Local governmental agencies involvement is not anticipated. The CARB has had experience with implementing retrofit programs in the past. It is assumed that implementation of the proposed heavy duty gasoline retrofit program would be assumed by CARB.

Inspection/maintenance (I/M) programs can be directly administered by the State, or franchised out to private contractors. Data from a pilot I/M program currently being operated in the South Coast Air Basin suggests that the operation of such programs might make disproportionate demands on the administrative resources of the State. Therefore, a private-operated/public-monitored program may be preferable for the Bay Area.

FinancialDirect Public Cost of Implementation

- o See Public Costs (a) in the column headed "Total Cost/Yr of Recommended Action."

Fiscal Effect on Local Government

- o No impact.

Production of Goods and Services

- o A slight increase in the production activity of some industries servicing the automobile manufacturing industry might occur as new tooling required to produce newly designed engines is needed. New engine design may stimulate substantial change in the automotive repair and service industry. The implementation of the inspection/maintenance (I/M) measures would add a new line of service for the California automotive service industry. Some services presently exist for identifying defective emission control equipment on cars. They are not, however, universally applicable to all California registered vehicles. I/M programs for light, medium, and heavy duty vehicles would offer a universally applied service program for identification and repair of vehicles with excessive emission caused by mal-adjusted or defective emission control equipment.

Income and Investment

- o See Private Costs (b) in the column headed "Total Cost/Yr of Recommended Action."

Consumer Expenditures

- o The manufacture of new engine technologies would necessitate an increase in the initial cost of new vehicles. This increase may be offset, however, by savings in operating cost throughout the lifetime of the vehicle. Catalytic converters are estimated to cost about \$350.00 per heavy duty vehicle. (Price includes cost of the device and installation charges.) For a light and medium duty vehicle I/M programs an inspection fee of \$5-6.00 per vehicle would be required. The average cost of repairs for the catalyst equipped vehicle is about \$45.00.

Housing Supply

- o No impact.

Physical Mobility

- o Because of increased cost of private transportation, the mobility of the limited income segment of the Bay Area population may be impaired. This would be particularly true for those located in other than urban centers.

Health and Safety

- o These control measures would substantially reduce carbon monoxide emissions from motor vehicles. Therefore, substantial health-related benefits may accrue to those segments of the population that experience the heaviest exposure to carbon monoxide concentrations while residing, working or shopping in urban centers.

Sense of Community

- o No impact.

Equity

- o The measures will adversely impact some groups in urban areas more severely than others--particularly those with limited income.

Urban Pattern

- o No impact.

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
III. Transportation controls						
GENERAL POLICY: REDUCE MOTOR VEHICLE EMISSIONS THROUGH TRANSPORTATION ACTIONS TO REDUCE VEHICLE USE						
Action 8 Increase tolls on bridges.	0.2	Not esti- mated sep- arately; included below with emission reductions due to compact develop- ment	Metropolitan Transportation Commission (MTC) and California Toll Bridge Authority	A - 1980 I - 1980	(\$13,000,000 ^b) - Toll revenues	AB 664
Actions 9 & 10 Implement regional parking strategy to discourage private auto use and encourage high-occupancy auto use.			Cities, counties, employers, MTC		- Parking charges	Local Municipal Tax Enabling Legislation
Action 9 - Parking tax	0.3			A - 1980 I - 1981	\$15,000 ^a \$(6,000,000 ^b)	
Action 10 - Preferential parking for carpools and vanpools	0.1			A - 1978 I - 1985	\$886,000 ^a	
Action 11 Provide additional transit service.	0.7		MTC, transit districts (e.g., MUNI, AC, BART)	A - 1978 I - 1985	\$18,540,000 ^a - Federal Mass Transportation Assistance Programs - Fare revenues - Local Trans- portation Development Act Funds - State Highway Trust Fund diversions	- Local Transit District Enabling Legislation - Bay Area Rapid Transit District Enabling Legislation - Interagency Memoranda of Understanding
Action 12 Increase bus and carpool lanes/ramp metering.	0.2		Caltrans, transit districts, cities and counties	A - 1979 I - 1985	\$7,438,000 ^a - Federal Aid Highway Programs - State Highway Programs funds	- AB 69 (State Transportation Planning Enabling Legislation) - AB 363 (Bay Region Trans- portation Planning Legislation) - Caltrans Enabling Legislation - Local Planning and Traffic Control Enabling Legislation
Action 13 Implement an auto control zone in San Francisco central business district to reduce traffic.	0.1		City of San Francisco	A - Previously adopted I - 1980	\$128,000 ^a - City General Funds - Local Trans- portation Development Act Funds	San Francisco Traffic Ordinances
^a Public agency ^b Private						

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS
<u>Air Quality</u> <ul style="list-style-type: none"> o See "Direct Benefits" column. 	<u>Institutional</u> <ul style="list-style-type: none"> o MTC and California Toll Bridge Authority can presently set toll rates. o Additional transit service would be provided by the present operators. o Ride sharing programs would be handled by a non-profit corporation now being established. o Caltrans would implement high-occupancy vehicle (HOV) lanes and carpool lots. o San Francisco would institute the auto control zone as specified in the Transportation Element of the San Francisco General Plan. o Cities and counties would implement bicycle measures. Private employers and businesses would be encouraged to participate. 	<u>Production of Goods and Services</u> <ul style="list-style-type: none"> o New employment in the transit sector. o Possible adverse effect on parking lot operators. <u>Consumer Expenditures</u> <ul style="list-style-type: none"> o Increase in cost of operating private autos. o Savings to those commuters utilizing carpools, vanpools or transit. 	<u>Housing Supply</u> <ul style="list-style-type: none"> o No impact. <u>Physical Mobility</u> <ul style="list-style-type: none"> ■ Additional transit service would increase mobility of all transit users. o Carpool/vanpool measures would increase travel options for most commuters. o Some restrictions on private auto access in the auto control zone. <u>Health and Safety</u> <ul style="list-style-type: none"> o Reduction in auto accidents with improved peak period flow. o Improved pedestrian safety in the auto control zone. o Possible increase in number, but not rate, of bicycle accidents with increased usage. <u>Sense of Community</u> <ul style="list-style-type: none"> o No impact. <u>Urban Patterns</u> <ul style="list-style-type: none"> o The combination of incentives like additional transit service and disincentives on private auto use will encourage a more compact land use pattern, with employees living closer to transit lines and/or their jobs.
<u>Water Quality</u> <ul style="list-style-type: none"> o No impact. 			
<u>Physical Resources</u> <ul style="list-style-type: none"> o No impact. 			
<u>Energy</u> <ul style="list-style-type: none"> o Gasoline savings from carpooling, the shift to transit, improved traffic flow, and the shift to bicycles. o Minor increase in transit fuel consumption. 			
<u>Amenities</u> <ul style="list-style-type: none"> o Cleaner air. o Improved pedestrian environment in auto-control zone. 	<u>Financial</u> <ul style="list-style-type: none"> o Certain measures, notable the additional transit services, bus/carpool/lanes, and bicycle systems, are rather costly. There is some funding available, but additional funds will be needed. o Other measures would generate revenue which could be used to finance the incentives mentioned above. 		<u>Equity</u> <ul style="list-style-type: none"> o Measures such as additional transit service will particularly benefit low income, handicapped and other persons who depend on this mode of travel. o Pricing disincentives will impact primarily middle income commuters who choose to continue driving their cars.

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
Action 14 Provide more ride sharing services such as jitneys and vanpools.	1.7 Not estimated separately; included below with emission reductions due to compact development	Caltrans, Employers, MTC	A - Previously adopted I - 1979	\$300,000 ^a	- Federal Mass Transportation Assistance Programs	Federal Energy Legislation
Action 15 Develop more extensive bicycle systems.	2.0	Cities, counties, MTC, Caltrans	A - 1980 I - 1985	\$438,000 ^a ^a Public agency ^b Private	- Federal-Aid Highway Programs - Local Transportation Development Act Funds	- Federal-Aid Highway Legislation - Local Transportation Development Act Legislation

IV. Development and land use management

GENERAL POLICY: ALTER REGIONWIDE DEVELOPMENT PATTERNS TO REDUCE AUTOMOBILE TRAVEL BY MEANS OF LOCAL AND REGIONAL POLICIES ON LAND USE AND URBAN SERVICES

The reductions in emissions are based on a total population in the region of 5.4 million. If the population were at the higher range projected (6.1 million), the emission reductions shown would be higher, but so would the total from which the reductions would be subtracted.	Not estimated 24	Cities, counties, Local Agency Formation Commissions, special districts, ABAG, BAAPCD, MTC, State Water Resources Control Board, California Department of Transportation, U.S. Department of Transportation, Environmental Protection Agency	A - 1978 I - 2000	Direct administrative and regulatory costs to be estimated when agencies specify actions they will take to carry out recommendation for compact development.	Depends on specific actions	Existing authority contained in California Government Code; Health and Safety Code; State Constitution; relevant Federal legislation.
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Policy A

EXTEND NEW DEVELOPMENT ONLY TO THOSE LOCATIONS WITH EXISTING SEWER AND WATER SERVICE OR SEWER AND WATER SERVICE COMMITTED IN CAPITAL IMPROVEMENT PROGRAMS.

Action 1

Local Agency Formation Commissions (LAFCOs) adopt city and special district spheres of influence throughout the region as soon as possible.

Action 2

LAFCOs adopt the "urban service area" concept for defining urban service commitments and projecting urban land needs for 5, 10 and 20 year periods.

Action 3

LAFCOs approve annexations and formation of cities and special districts consistent with Action 2 findings on urban service commitments and urban land needs.

Action 4

Counties and cities enact non-urban zoning outside urban service areas.

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS
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<u>Air Quality</u> <ul style="list-style-type: none"> o See "Direct Benefits" Column. 	<u>Institutional</u> <ul style="list-style-type: none"> o Would mean significant changes in planning and zoning administration-related activity (e.g., amendment of regional and local general plans, zoning ordinances and subdivision regulation revisions, etc.). o Greater coordination would be needed among local agencies whose decisions affect development. o Would require increased governmental coordination and technical support to facilitate local action. 	<u>Production of Goods and Services</u> <ul style="list-style-type: none"> o Would be conducive to increased transit service. o Would increase transit-related employment. o Would increase job opportunities in urban areas. o Would increase commercial activities in urban areas. o Would mean less commercial growth in outlying areas. 	<u>Housing Supply</u> <ul style="list-style-type: none"> o Would increase conversions of older urban area single-family structures. o Would lower proportion of substandard units region-wide due to rehabilitation and redevelopment efforts. o May cause temporary lag in new residential construction in urban areas as builders adjust to zoning and subdivision regulation changes. o Would reduce new residential construction in outlying areas within the region. o Would increase new construction and rehabilitation activity throughout urban areas, particularly older development areas.
<u>Water Quality</u> <ul style="list-style-type: none"> o Would provide greater preservation of outlying area watersheds, estuarine system and groundwater recharge areas. o Would lower per capita consumption rates of municipal and domestic water supplies due to increased development densities (e.g., smaller lawns, etc.). o Would provide regionwide reduction in surface runoff pollution due to less impervious surface coverage (streets, highways, rooftops, etc.). o Would mean higher localized surface runoff pollution in urban areas due to increased densities. 	<u>Financial</u> <ul style="list-style-type: none"> o Greater use of excess capacity in urban public service facilities (e.g., sewers, schools, etc.) may result in lower user charges, taxes, etc. o Would mean a major reduction regionwide in capital construction costs due to limited extension of public services (e.g., highways, sewer collectors, water lines, etc.). o More efficient solid waste collection due to higher densities could result in lower collection costs. o Would increase tax base for urban areas. o Individual property tax assessments may increase, then level off. o Sales tax revenue would be increased in urban centers. o Increased government administration costs would be expected. o Fee and user charges may increase in certain outlying areas. 	<u>Income and Investment</u> <ul style="list-style-type: none"> o Would lower regionwide demand for investment due to reduced public capital requirements. o Would shift emphasis of public and private financial investment from outlying areas to urban areas for renovation and replacement. o Would stimulate housing rehabilitation and maintenance industries. o Would stimulate higher density residential production. o May affect housing industry profit/cost structure. o Residential land prices would increase in the urban centers and close-in areas (e.g., increased site preparation costs for bypassed land) and decline in outlying areas beyond urban services. o Industrial land prices not significantly impacted due to large industrial land supply within urban areas. <p>(continued, next page)</p>	<u>Physical Mobility</u> <ul style="list-style-type: none"> o Could increase transit availability for all trip purposes (e.g., work, school, recreation, shopping, etc.) and for transit-dependent residents. o Would increase pedestrian activity as urban services are brought within closer proximity. o Would reduce regionwide total vehicle miles traveled. o Would mean shorter trips by automobile resulting in increased travel time savings. o Local traffic congestion may increase as local streets are used more. o Would mean greater inconvenience for private automobile uses (e.g., parking might be more difficult to find). <p>(continued, next page)</p>
<u>Physical Resources</u> <ul style="list-style-type: none"> o Less conversion of undeveloped land to urban uses would increase regionwide preservation of critical environmental areas (e.g., prime agricultural lands, ecological habitats such as marshes, steep slopes and flood-prone areas). o Would reduce conversion of agricultural land to urban uses. o Would reduce damage to flora and fauna due to lower pollutant concentrations. o Could reduce conversion of mineral, timber, quarry and geothermal areas to urban uses. o Could increase development pressure on land uniquely suited for special development purposes in urban areas (e.g., airports, parks). <p>(continued, next page)</p>			

AIR QUALITY MAINTENANCE PLAN RECOMMENDATIONS (continued)

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
Action 5 Counties and cities enact temporary moratoria on urban zoning and subdivisions outside urban service areas pending the enforcement of non-urban zoning in such areas.						
Policy B RESTRICT DEVELOPMENT OUTSIDE URBAN SERVICE AREAS IN AREAS OF CRITICAL ENVIRONMENTAL CONCERN (ENVIRONMENTAL RESOURCES, HAZARDS, OR AMENITIES).						
Action 6 Counties and cities enact agricultural zoning or large-lot rural residential zoning (generally one dwelling unit per 40 acre minimum lot size). Action 7 Counties and cities initiate, continue or expand programs under the California Land Conservation Act (Williamson Act), the Open Space Easement Act of 1974 and the Z'berg-Warren-Keene-Collier Forest Taxation Reform Act of 1976 outside urban service areas. Action 8 Counties, and cities establish programs of public land management including acquisition, purchase/leaseback, purchase/transfer of development rights, etc.) for locations outside urban service areas.						
Policy C DEVELOP UNIMPROVED LAND WITHIN URBAN SERVICE AREAS WHERE URBAN SERVICES EXIST OR ARE COMMITTED IN CAPITAL IMPROVEMENT PROGRAMS.						
Action 9 ABAG, counties, cities and LAFCOs establish "early warning" inter-agency information exchange programs concerning urban service facility plans at the earliest stages of project planning. Action 10 ABAG, counties, cities, and LAFCOs expedite plan or project reviews where early information on facilities has been provided, under Action 9. Action 11 Counties and cities initiate rezoning and permit preference procedures in locations with existing but unused service capacities (with emphasis on water, sewer, transportation and school services).						

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS
<u>Energy</u> <ul style="list-style-type: none"> o Would reduce gasoline consumption due to less automobile travel. o Would increase consumption of transit-related fuel. o Would provide overall reduction in transportation fuel consumption. o Would lower per unit household energy consumption. 	<u>Amenities</u> <ul style="list-style-type: none"> o Would preserve scenic areas. o Would improve visibility regionwide. o Would increase numbers of people exposed to noise levels of urban areas. 	<u>Consumer Expenditures</u> <ul style="list-style-type: none"> o Could increase housing prices and rents for a short time due to any production lags as builders adjust to zoning and subdivision regulation changes. o Would reduce increases in residential waste collection charges. o May cause increases in urban area property taxes to support services to new development and because of increased land values. o Would reduce increases in residential and commercial energy charges. o Could mean more disposable income due to lower transportation costs. o May shift housing demand outside Bay Area o May affect consumer housing preference. 	<u>Health and Safety</u> <ul style="list-style-type: none"> o Would significantly improve public health due to reduced oxidant concentrations regionwide. o May cause greater exposure to localized CO pollutant concentrations, depending on the success of technological controls and the amount of increase in use of transit. o Could increase pedestrian safety problems on local streets. <u>Sense of Community</u> <ul style="list-style-type: none"> o Would enhance neighborhood identities due to diversity and density of activity. o Adverse social effects may result from higher density development. o Would increase time for non-work activity due to shorter commutes. <u>Equity</u> <ul style="list-style-type: none"> o Could expand transit availability for transit-dependent residents. o Would broaden housing opportunities if lower per dwelling unit costs are passed on to residents. o Rehabilitation and redevelopment would probably displace poor, aged, minority and handicapped residents. o Budgets of those on low- and fixed incomes may be adversely affected due to possible cost of living increases in renewed areas.

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
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Policy D

COMPLETE, AS SOON AS POSSIBLE, ALL NEEDED SEWER, WATER OR TRANSPORTATION SERVICE IMPROVEMENTS WITHIN ADOPTED URBAN SERVICE AREAS.

Action 12

LAFCDs review all city, county, or special district sewer, water, or transportation service capital improvement programs and report on priority needs within each urban service area.

Action 13

ABAG review sewer, water and transportation needs within all urban service areas to determine region-wide priorities among such service needs.

Action 14

ABAG favorably review applications for State/Federal financial assistance from agencies lacking service capacity within urban service areas, where other existing or committed services have been found by the LAFCD to be capable of accommodating additional development.

Policy E

IMPROVE HIGHWAY, STREET, ROAD AND TRANSIT SYSTEMS CONSISTENT WITH LOCAL ACTIONS TO STAGE LAND DEVELOPMENT.

Action 15

Counties and cities enact planning and zoning regulations to stage land development consistent with the scheduling of urban services (including but not limited to "development sequence zoning", "tiered zoning districts", development timing permits etc.).

Action 16

Caltrans, MTC, counties, cities, and special districts plan, program, fund and construct highway, street, road and transit improvements consistent with local action to stage land development.

Policy F

INCREASE HOUSING AND JOB OPPORTUNITIES IN EXISTING URBANIZED AREAS BY ENCOURAGING PUBLIC AND PRIVATE REBUILDING INTO COMPATIBLY MIXED COMMERCIAL, INDUSTRIAL AND RESIDENTIAL LAND USES.

Action 17

Counties and cities initiate and/or expand housing conservation programs in existing urbanized areas.

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
<p>Action 18 Counties and cities initiate and/or expand commercial and industrial development and redevelopment in existing urbanized areas.</p> <p>Action 19 Counties, cities and special districts initiate and/or expand incentives to public and private redevelopment in urbanized areas. Emphasis would be on sewer and water facilities, and extensive transit service improvements, but should also include educational and cultural facilities and public safety service improvements where appropriate.</p> <p>Action 20 ABAG, counties and cities analyze possible local revenue reforms to provide adequate financial resources to carry out Action 19.</p> <p>Action 21 ABAG support State legislation to provide local governments with adequate fiscal resources to carry out Action 19.</p> <p>Action 22 ABAG oppose Federal and State legislation that would hamper the ability of local governments to carry out rebuilding programs to increase job and housing opportunities in existing urbanized areas.</p>						
<p>Policy G ENCOURAGE "INFILL" DEVELOPMENT OF BYPASSED VACANT LAND WITHIN URBAN SERVICE AREAS.</p> <p>Action 23 Counties and cities undertake planning studies to inventory bypassed land, identify development problems, and resolve questions of best potential use.</p> <p>Action 24 Counties and cities adopt necessary changes in zoning and permit procedures to facilitate development of bypassed parcels affected by special conditions.</p> <p>Action 25 Service agencies design sewer, water and transportation systems to improve accessibility and service ability of bypassed vacant land in existing urban communities.</p>						

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
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Policy H

DEVELOP AT HIGHER DENSITIES WITHIN SERVICE AREAS WHERE EXISTING OR COMMITTED URBAN SERVICE CAPACITIES, INCLUDING TRANSIT, CAN SUPPORT THE HIGHER DENSITIES.

Action 26

In urban service areas with adequate sewer, water and transit capacities, counties and cities rezone appropriate locations to permit higher densities.

Action 27

Counties and cities enact ordinances (such as those for planned unit development or cluster zoning) to foster higher densities on appropriate sites.

Policy I

LIMIT DEVELOPMENT OF LAND WITHIN URBAN SERVICE AREAS WHERE SOIL, SLOPE, OR OTHER CONDITIONS CAN SUPPORT ONLY LOW-DENSITY DEVELOPMENT.

Action 28

Counties, cities and special districts deny primary urban services to these locations by excluding them from capital improvement programs and design of service systems, and by enactment of hookup moratoria, etc.

Action 29

Counties, cities, and special districts establish programs of public land management (including but not limited to public land acquisition, purchase/transfer of development rights, purchase/leaseback, etc.) to maintain appropriate sites in open uses.

Policy J

IMPROVE THE BALANCE OF JOBS AND HOUSING IN JURISDICTIONS THROUGHOUT THE REGION TO REDUCE THE NECESSITY FOR LONG DISTANCE HOME-TO-JOB TRAVEL.

Action 30

Cities and counties adopt programs to increase local employment opportunities if a substantial proportion of their residents work elsewhere.

Action 31

Cities and counties adopt programs to increase local housing opportunities in a price range suitable for their work forces if a substantial proportion of their work forces live elsewhere.

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
Action 32 ABAG conduct A-95 and EIR reviews to support local government efforts to improve the balance of jobs and housing in communities throughout the region.						
Action 33 ABAG support State and Federal funding allocations for facilities and programs offering incentives to economic development or housing development in appropriate jurisdictions.						
Policy K MIX RESIDENTIAL/COMMERCIAL AND INDUSTRIAL DEVELOPMENT IN COMMUNITIES THROUGHOUT THE BAY REGION.						
Action 34 Counties and cities revise zoning ordinances to allow compatible mixtures of land uses with adequate design or performance standards (including planned unit developments, performance standard zoning, etc.).						
Action 35 Counties and cities expand application of conditional use permits where appropriate.						
Policy L DISCOURAGE NEW LARGE-SCALE LAND DEVELOPMENT PROJECTS THAT ARE EXCLUSIVELY COMMERCIAL, INDUSTRIAL OR RESIDENTIAL, UNLESS SUCH PROJECTS CLEARLY DEMONSTRATE THAT THEY IMPROVE THE OVERALL BALANCE OF JOBS AND HOUSING IN THAT CITY, COUNTY, OR SUBREGION.						
Action 36 Counties, cities and LAFCOs deny incorporation or annexation of large-scale development proposals that are exclusively commercial, industrial or residential, unless such incorporation or annexation can be shown to improve the overall balance of jobs and housing in the city, county, or subregion.						
Action 37 MTC, the California Department of Transportation and transportation districts deny regional transportation system access or extension to proposed large-scale land development projects that are exclusively commercial, industrial or residential unless such transportation actions can be shown to improve the overall balance of jobs and housing in the city, county or subregion.						

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

AIR QUALITY MAINTENANCE PLAN RECOMMENDATIONS (continued)

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
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Policy M

FUND NEW WASTEWATER AND TRANSPORTATION FACILITIES ONLY AFTER AREAS SERVICED HAVE TAKEN ACTIONS TO CARRY OUT ACTIONS OF THIS PLAN.

Action 38

The State Water Resources Control Board and the Environmental Protection Agency require applicants for wastewater facilities under Section 201 of the Federal Water Pollution Control Act to demonstrate, prior to construction funding, that specific actions (including but not limited to land development regulations, urban service commitments, etc.) have been taken by affected jurisdictions to carry out actions of this plan.

Action 39

The U.S. Department of Transportation, the California Transportation Commission, the California Department of Transportation and the Metropolitan Transportation Commission require applicants for transportation improvement grants to demonstrate, prior to funding for acquisition and construction that specific actions (including but not limited to land development regulations, urban service commitments, etc.) have been taken by affected jurisdictions to carry out actions of this plan.

Policy N

REVIEW DEVELOPMENT PROPOSALS FOR AIR QUALITY EFFECTS AND CONSISTENCY WITH COMPACT DEVELOPMENT RECOMMENDATIONS IN THE PLAN. (INDIRECT SOURCE REVIEW)

Action 40

ABAG, BAAPCD and MTC adopt memoranda of understanding and procedures for prompt and thorough joint review of significant development proposals. Review would be conducted for proposals (such as shopping centers, industrial parks, office complexes, etc.) where significant air pollution could result from the project's generation of auto traffic.

Action 41

BAAPCD adopt permit procedures for application to indirect sources.

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

AIR QUALITY MAINTENANCE PLAN RECOMMENDATIONS (continued)

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2000	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
Action 42 ABAG encourage and support local government efforts to determine direct and indirect effects on air quality in making local land use decisions. Such support shall include technical assistance and analysis.						
Action 43 ABAG encourage and support local government efforts to reduce adverse effects of development proposals on air quality, including but not limited to assistance in identifying and implementing mitigation measures for adverse impacts of municipal wastewater facilities and transportation improvement programs.						
Policy O ADOPT FINANCIAL PROGRAMS TO SUPPORT LOCAL AND REGIONAL AGENCY ACTIONS AND PRIVATE SECTOR DEVELOPMENT ACTIONS CONSISTENT WITH POLICIES IN THIS CHAPTER TO REDUCE HOME-TO-WORK DISTANCE AND AUTO DEPENDENCY.						
Action 44 ABAG, counties and cities support State and Federal legislation to provide subventions and other fiscal assistance to cities and counties carrying out development policies to achieve air quality standards.						
Action 45 ABAG, counties and cities support State and Federal legislation providing tax incentives to the private sector for rebuilding and development within existing urbanized areas.						
Action 46 ABAG, counties and cities support State and Federal legislation providing financial support to local and regional agencies for carrying out development management policies and reviews to achieve air quality standards, especially to mitigate adverse impacts on low- and moderate-income households.						

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

RECOMMENDATIONS	DIRECT BENEFITS (Hydrocarbon emission reductions, tons/day) 1985 2003	IMPLEMENTING AGENCY (or agencies)	SCHEDULE FOR ACTION A - Adoption I - Fully Implemented	TOTAL COST/YEAR OF RECOMMENDED ACTION	FINANCING MECHANISM	LEGAL AUTHORITY
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Policy P

ADOPT A COORDINATED REGIONWIDE PROGRAM FOR CARRYING OUT ACTIONS FOR ATTAINMENT AND MAINTENANCE OF AIR QUALITY STANDARDS THROUGH DEVELOPMENT AND LAND USE MANAGEMENT ACTIONS BY CITIES, COUNTIES, SPECIAL DISTRICTS, ABAG, BAAPCD, MTC, LAFCOs AND OTHER APPROPRIATE LOCAL AND REGIONAL AGENCIES.

Action 47

ABAG identify, within six months of General Assembly adoption of an initial air quality maintenance plan, which implementing actions are being carried out by local and regional agencies.

Action 48

ABAG include, in each annual revision of the AQMP, agreements reached among local and regional agencies for carrying out land use and development management actions included in the initial AQMP.

Action 49

ABAG shall include, in each annual revision of the AQMP, an identification of actions not being carried out by all appropriate agencies, and which actions are to be carried out by appropriate agencies by the next annual revision of the AQMP.

ENVIRONMENTAL IMPACTS	INSTITUTIONAL/FINANCIAL IMPACTS	ECONOMIC IMPACTS	SOCIAL IMPACTS

amount of organic solvent used per area of surface coated. This may be done by substituting water as the solvent (water based coatings) or by increasing the proportion of solids to solvent (high solids coatings).

Action 2: Use closed systems for storage and transfer of organic liquids.

The petroleum refining and marketing industry, plus other industries storing organic solvents, emits a substantial quantity of hydrocarbons from storage tanks, approximately 88 tons per day as projected to 1985. Storage tanks without controls emit vapors as "breathing losses." Each time a tank is filled with liquid the vapors inside the tank are forced out. Breathing losses have been controlled for many years by use of the floating roof, a tank roof that literally floats upon the surfaces of the liquid, moves up and down with that surface, and eliminates the space in which vapors could accumulate. BAAPCD regulations require such floating roofs.

The floating roof is a very effective device, attaining over 90% control, but still permits source evaporation around the edges. The large number of tanks involved and the large volume of petroleum handled result in the tonnage of emissions noted previously.

In addition to requiring floating roofs on large storage tanks, vapor units are presently required in gasoline transfer operations between tank and delivery trucks, between delivery trucks and service station tanks, and in auto filling.

To insure the maximum degree of control, approaching 100% on individual installations, this measure would require actually closed systems, without, for instance, gaps as at the edges of the floating roof. This would require a vapor recovery unit to condense and return the vapors to liquid form, or connection to a fuel system where the vapors would be burned as fuel. For maximum control, stand-by duplicate recovery units would be required.

This recommendation was proposed to attain maximum control. The CARB has proposed a measure requiring alteration of the floating roof by installing an additional (secondary) seal and tightening the limitations on primary seal gap size. This measure would provide a somewhat lesser increment of additional control, but probably at a much lower cost.

The California Air Resources Board proposal 1) requires secondary seals on existing floating roof tanks 2) sets the maximum allowable emissions from fixed roof tanks 3) requires vapor recovery systems to be 90% efficient up to March 1980 and 95% efficient thereafter 4) requires that vapor recovery systems on storage tanks constructed after November 1, 1977 be 95% efficient. The CARB has imposed this regulation on the South Coast Air Quality Management District.

Action 3: Require best available control technology (BACT) on new and existing sources.

The legislation establishing the BAAPCD did not permit the BAAPCD to specify control equipment to be used in meeting control regulations and emission limitations. Therefore, until recently, all BAAPCD regulations were performance regulations. The regulation specified limits on the amount, concentration, or visible appearance of the emission; the means of complying with the regulation was the prerogative of the operator of the source.

More recently, State laws have been altered to remove the prohibition against specification of equipment thus allowing the BAAPCD to require the use of the most effective technology actually available and proven in use, not necessarily in the Bay Area. It does not include unproven theoretical devices.

Examples of specific industrial and commercial process affected and the types of technologies which could be required are listed below:

<u>Process</u>	<u>Technology</u>
Organic Storage	Dual and parallel vapor recovery
Tar Pots	Loading door assembly
Paint Spray Booth	Incinerator or low/no solvent coatings
Architectural Coating	Low solvent coatings
Dry Cleaning	Closed system with solvent recovery
Chemical Milling	Fume incinerators
Cable Tar Coating	Incineration
Gasoline Bulk Storage	Floating roof or fixed roof plus vapor recovery
Auto Service Station Storage Tanks	Closed balanced system with secondary system
Auto Fill Operations	Secondary vacuum assist system

A BACT rule would require that both existing and future operations use specified air pollution control techniques, such techniques being specified by the BAAPCD. The rule could be adopted by the end of 1979, but five years should be allowed for full implementation.

Action 4: Continue the review of new and modified industrial and commercial facilities (New Source Review/NSR).

Since July of 1972 the BAAPCD has had in effect a permit rule (Division 13, Regulation 2) specifying the authority to deny a permit to construct (Section 1309) or to operate (Section 1310) if the new source will "interfere with the attainment or maintenance of any air quality standard adopted by the California Air Resources Board or the Environmental Protection Agency...."

Section 1311.2 of that same regulation specifies that a permit will not be denied if the emissions of each contaminant from a facility are significantly less than from the original facility. Thus a degree of off-set is acknowledged, i.e., if emissions from existing operations are reduced by more than the emissions from a new operation, the new operation will be allowed. It is important to understand that Section 1311.2 is interpreted to mean that the reduction of existing emissions must be accomplished from facilities operated by the same owner, i.e. the owner of the proposed facility, and at the same location. Additionally, Section 1311.2 requires off-set to be for the same pollutant type, e.g., SO₂ for SO₂, not carbon monoxide for hydrocarbons.

This action would retain the present BAAPCD permit rule with or without expansion of or modifications to the off-set provisions. Depending on the success of all other air pollution controls recommended in this plan, the New Source Review rule would require:

- The prohibition of some new industries with significant emissions (for example, an industry that cannot meet the New Source Review criteria or could not obtain the designated emission off-set).

- o Increased cleanup from existing sources through off-sets/negotiation, or in some cases prohibition of modifications proposed by existing sources

II. General Policy: Minimize Hydrocarbon Emissions from Motor Vehicles

The actions necessary to implement this policy change with time. Initially, effort would be focused on implementing exhaust controls on gasoline powered trucks and a program of mandatory vehicle inspection and maintenance for both autos and trucks. These programs will act to minimize emissions from existing vehicles. On a longer term basis, more stringent vehicle emission standards are recommended as new engine technologies become available for mass production. The mandatory inspection and maintenance program would still be necessary on a long term basis to ensure that the newer, cleaner vehicles being produced continue to perform at their design levels after they have been operated for some time.

Action 5: Adopt and implement more stringent vehicle (light duty and heavy duty) hydrocarbon exhaust emission standards--approximately 50% below the ultimate level currently prescribed by State and Federal regulations.

Currently promulgated emissions standards for motor vehicles will achieve substantial emissions reductions from light and heavy duty vehicles in the period 1980-1985. These reductions, however, will eventually be offset by growth in vehicle population and vehicle miles travelled that is anticipated between 1985 and 2000. For example, in 1985, baseline motor vehicle hydrocarbon emissions are projected to be 213 tons per day. In 2000, the emissions increased to 267 tons per day.

The recommendation requires that the exhaust emission characteristics of vehicles manufactured after 1990 be reduced by:

- 50% from the ultimate levels promulgated under the 1970 Clean Air Act Amendments for light duty vehicles. The requirements (i.e. grams per mile standards) in the 1977 Amendments are approximately the same as the 1970 Clean Air Act.
- 50% from the ultimate 1983 Air Resources Board standards for medium and heavy duty vehicles.

The resultant emission standards would be:

	grams/mile		
	HC	CO	NOx
light duty	.20	1.70	.40
medium duty	.25	4.50	.15
heavy duty*	.25	12.50	4.5

*grams brake horse power

Action 6: Implement a mandatory annual inspection and maintenance program for light and heavy duty vehicles.

While automobile emissions can be controlled by a variety of basic engine modifications and exhaust treatment devices, the state of tune of the vehicle also affects emissions significantly, regardless of what emission standards the vehicle was originally designed to meet. For example, misfiring spark plugs can increase unburned hydrocarbon emissions tenfold. An incorrectly adjusted idle air/fuel ratio can double carbon monoxide emissions. Defective emission control components can cause the emissions of late model cars to equal those of uncontrolled vehicles. A program for identification and repair of vehicles with excessive emissions caused by maladjusted or defective components has the potential to significantly reduce automotive emissions.

The recommendation requires inspection of all light duty automobiles starting in 1982 and the inspection of medium duty vehicles beginning in 1985. The inspections (which would take about five minutes) consists of: visual safety inspections, visual inspection of the emission control systems and exhaust smoke; automatic computer analysis of carbon monoxide and hydrocarbon exhaust gas emissions (could also include oxides of nitrogen, if loaded tests were performed), and an automatic printout of the inspection report comparing the emissions measured to acceptable limits for that particular model. If the vehicle fails the inspection it is required to be repaired by a certified mechanic and then be reinspected. If the vehicle cannot be repaired in order to meet the standard of performance for under a pre-established amount (e.g. \$75) then the vehicle owner may be given a waiver for that year. This would not relieve the vehicle owner from future year inspections.

Action 7: Require exhaust emission control devices on existing heavy duty gasoline vehicles.

The regulation of emission levels from heavy duty vehicles (over 6,000 pounds gross vehicle weight) has lagged behind efforts to control light duty vehicle emissions. The slower turnover rate for heavy duty vehicles means they remain in use for a longer time than light duty vehicles. Thus, even with emissions standards for heavy duty vehicles, some control program is needed to minimize emissions from in-use vehicles before they are replaced by newer and cleaner vehicles.

The recommendation requires that all heavy duty gasoline (HDG) vehicles manufactured in 1971-1982 be retrofitted with a catalytic converter by 1985. Diesel vehicles are exempted because they emit relatively small amounts of hydrocarbons and because it is impractical to install a converter. Pre-1971 models are exempt because they require leaded gasoline (leaded gasoline contaminates the catalyst). Post-1982 vehicles are assumed to be equipped with catalysts in order to meet the 1982 emissions standards already adopted by the California Air Resources Board.

III. General Policy: Reduce Motor Vehicle Emissions Through Transportation Actions to Reduce Vehicle Use

The objectives of the transportation actions recommended are to discourage use of the "drive alone automobile" and to encourage use of public transit

and other high occupancy vehicle travel modes. The actions include both economic and physical incentives and disincentives to accomplish the objectives. In addition, the revenues generated through application of economic disincentives is used primarily to fund transit service improvements.

Action 8: Increase tolls to \$1.25 during peak traffic periods and \$1.00 during off-peak periods for all trans-bay bridges.

This measure should discourage driving alone and encourage transit use and carpooling. The net effect should be a reduction in vehicular travel. A toll increase could provide an attractive secondary benefit. A significant increase in revenue which could be made available for future transit service extensions. After extensive public review and environmental documentation, the Bay Bridge, San Mateo Bridge and Dumbarton Bridge tolls were raised to 75¢ in July 1977, raising an estimated \$8 million which is available for transit.

The toll increase would be implemented on each bridge when adequate alternative transit service becomes available on that facility. In addition, the existing preferential treatment given to buses and carpools on the Bay Bridge and the Golden Gate Bridge would be continued.

Action 9: Implement a regional parking tax. A 35% parking tax would be applied to all vehicles entering paid parking facilities between 6 and 10 a.m.

This measure would increase the cost of driving for commuters, but would not unduly restrict shoppers or other short-term visitors. The commuter has more transit alternatives and, because of the repetitive nature of his trip, is more susceptible to transit and carpool incentives. This measure would also help to reduce peak period congestion and conserve energy.

San Francisco levied a 25% tax on parking receipts in 1970. Some operators responded by absorbing the tax, thereby reducing their profits. The tax was reduced to 10% in 1972, but was recently raised to 15%.

The parking tax would have to be implemented regionwide to insure equity among the major cities. To accomplish this, legislation would be required giving regional authority to set the level of parking tax. Since most cities already have agencies that monitor parking operations, they would be the likely candidates to collect and monitor the tax. The tax would be a business license tax based on revenue purposes. The revenues could then be used to augment the city's general fund and to provide additional regional transit service.

Action 10: Require provision of preferential parking for carpools.

Preferential parking would be provided to carpools by giving them a) reduced parking charges in areas with paid parking, such as central business districts, or b) a time savings in areas of free parking, such as large suburban employers.

Carpooling can be one of the more effective ways of improving the efficiency of the transportation systems, both from an air quality and operations viewpoint. However, people are frequently reluctant to carpool because of the time lost in picking up members.

The carpool parking incentives are modelled after a program that Caltrans is currently testing. State lots are leased to operators at a reduced rate on condition that 1) they only allow carpools to park, and 2) charge no more than \$10/month. Carpools sign up for a space and there is currently a waiting list.

The time incentive would work by having large employers set aside close-in parking for carpools. This would compensate for the time lost in the pick-up phases.

Action 11: Provide additional transit service throughout the region, with an interim goal of a 20% increase in transit capacity by 1985.

The additional service would help make transit more competitive with respect to the auto by providing more coverage or better frequency. Existing funding services could not support this new burden. Additional revenues, such as the parking taxes or toll increases would be required.

The expansion program would be phased over 5 years, and would begin in 1980.

Action 12: Provide additional bus and carpool lanes and/or ramp metering on selected freeway segments.

Some form of preferential treatment (special lanes on the freeways and/or ramp metering with special lanes on ramps) would be given to buses and carpools on the following freeway segments:

- Route 580 from Route 24 to the Bay Bridge
- Route 80 from San Pablo Dam Road to the Bay Bridge
- Route 101 from the San Francisco Airport to the Route 280 Diamond Lane.

Since these would require detailed planning, funding approval and construction, they would not be operational until 1985.

This measure is another incentive to induce commuters to take transit or to form carpools by saving them time. These particular segments of freeway are frequently congested during peak hours and preferential treatment could result in significant time savings.

Action 13: Implement an Auto Control Zone in the San Francisco central business district to be serviced directly by public transit.

European experiments with Auto Control Zones have shown an ability to reduce markedly noise and air pollution within congested urban centers. By creating an Auto Control Zone within a small sector of the San Francisco central business district, the automobile commuter bound for this area would have to walk further. As the zone would be serviced directly by transit, the transit rider would experience no increase in walking time and an increase in ridership can be expected. An improvement in regional air quality would result from reducing the amount of traffic bound for the central business district. Local carbon monoxide "hot spots" would be eliminated because of reduced vehicular congestion.

The transportation Element of San Francisco's Master Plan calls for an auto control zone in the central business district. It is possible that this measure could be fully implemented by 1981.

Action 14: Expand a regional scale carpool matching and vanpooling program.

Currently, a carpool matching program, RIDES, is being administered by Caltrans. It is aimed at major employment centers, with participants solicited primarily by general advertising campaigns. This has been a successful program to date, but the AQMP proposal would intensify the effort. Increased employer participation would be sought for direct employee contact or adjustment to flexible working hours. Also, secondary employment centers could be served by tailoring campaigns to specific areas.

With respect to vanpools, the Golden Gate district is starting a demonstration program to initiate vanpools from Marin County. A program such as this could be expanded to the regional level. One proposal is for a non-stock, non-profit corporation to provide standardized minimum risk leases of vans to employers and employee groups meeting the criteria for such a program. Lease terms and specifications could be prearranged through a competitive bidding procedure.

Action 15: Implement a comprehensive system of bicycle paths and storage facilities.

The system would be directed toward major employment centers, commercial centers, and transit terminals throughout the region. The paths would be painted on existing streets with approximately one-half mile intervals between parallel paths. Storage would comprise lockers, racks, and whatever special storage areas may be provided by the private sector. Initial planning for the measure would commence in 1978. The physical construction of the system would begin in 1980 and continue through 1985.

This measure has the potential to improve regionwide air quality by diverting both work and non-work trips of less than 2.5 miles to bicycles. Sunny and warm days, when the photochemical problem is most serious, are also the most conducive to bicycle riding. Emissions from cold starts and hot soaks, will produce the majority of mobile emissions by 1985. Thus, even though bikes would not reduce vehicle miles travelled significantly, they will have a significant impact on emissions by reducing the number of trips.

IV. General Policy: Alter regionwide development patterns to reduce automobile travel by means of local and regional policies on land use and urban services.

Analysis of development trends in the Bay Area shows that distances between home, work, shopping, school and recreation are increasing in ways that will cause more serious air pollution. This is because development is becoming ever more scattered, at lower density, with more separation between where people live and where they go. In many fringe areas, development occurs without sewer, water or transit service. Older city areas are bypassed, with little rebuilding or use of vacant land where urban services already exist or are committed. Densities get even lower because the preponderance of residential construction is for single-family homes or large suburban lots. Densities are also getting lower because of the need for large lots

in locations where health and safety dictate it to accommodate use of septic tanks and wells, as well as to enable building on steeper slopes. The pattern of urban sprawl results in increasing dependence on the automobile. More people must use the auto for more purposes at ever greater distances. The policy suggested is to reduce auto dependency and thereby improve air quality.

The general policy stated above has 16 more specific policies and 49 actions indicating what government agencies would need to do to alter development patterns to bring about more compact development. The policies and actions include adopting urban services areas, extending development consistent with those areas, building on bypassed land within existing areas. They also involve encouraging densities consistent with earlier local practice (e.g. the 1900s and 1930s), and would allow in certain instances mixed residential, commercial and industrial areas. They also would mean adopting programs to reduce the imbalance between jobs and housing throughout the region, so that distances between jobs and homes can be shortened. The compact growth policies and actions described in this chapter would reduce automobile emissions and improve air quality. They are a more precise statement of the city-centered policy adopted by the ABAG General Assembly in the Regional Plan of 1970 and the General Assembly's growth policy actions of 1973 and 1974. Some of the policies and actions are already being carried out by some local jurisdictions in the Bay Area. Not all actions would be required of every city and county--or every public agency involved. Specific actions would be determined in cooperation with the jurisdictions involved in the first and subsequent years of the continuing planning process.

The policies and actions are as follows:

Policy A: Extend new development only to those locations with existing sewer and water service or sewer and water service committed in capital improvement programs.

Action 1: Local Agency Formation Commissions (LAFCOs) adopt city and special district spheres of influence throughout the region as soon as possible.

Action 2: LAFCOs adopt the "urban service area" concept for defining urban service commitments and projecting urban land needs for 5, 10 and 20 year periods.

Action 3: LAFCOs approve annexations and formation of cities and special districts consistent with Action 2 findings on urban service commitments and urban land needs.

Action 4: Counties and cities enact non-urban zoning outside urban service areas.

Action 5: Counties and cities enact temporary moratoria on urban zoning and subdivisions outside urban service areas pending the enforcement of non-urban zoning in such areas.

Policy B: Restrict development outside urban service areas in areas of critical environmental concern (environmental resources, hazards, or amenities).

Action 6: Counties and cities enact agricultural zoning or large-lot rural residential zoning (generally one dwelling unit per 40 acre minimum lot size).

Action 7: Counties and cities initiate, continue or expand programs under the California Land Conservation Act (Williamson Act), the Open Space Easement Act of 1974 and the Z'berg-Warren-Keene-Collier Forest Taxation Reform Act of 1976 outside urban service areas.

Action 8: Counties and cities establish programs of public land management (including acquisition, purchase/leaseback, purchase/transfer of development rights, etc.) for locations outside urban service areas.

Policy C: Develop unimproved land within urban service areas where urban services exist or are committed in capital improvement programs.

Action 9: ABAG, counties, cities and LAFCOs establish "early warning" inter-agency information exchange programs concerning urban service facility plans at the earliest stages of project planning.

Action 10: Expedite city, county, LAFCO or ABAG project reviews where needed information on service capacities has been provided under Action 9 above.

Action 11: Counties and cities initiate rezoning and permit preference procedures in locations with existing but unused service capacities (with emphasis on water, sewer, transportation and school services).

Policy D: Complete, as soon as possible, all needed sewer, water or transportation service improvements within adopted urban service areas.

Action 12: LAFCOs review all city, county, or special district sewer, water, or transportation service capital improvement programs and report on priority needs within each urban service area.

Action 13: ABAG review sewer, water and transportation needs within all urban service areas to determine regionwide priorities among such service needs.

Action 14: ABAG favorably review applications for State/Federal financial assistance from agencies lacking service capacity within urban service areas, where other existing or committed services have been found by the LAFCO to be capable of accommodating additional development.

Policy E: Improve highway, street, road and transit systems consistent with local actions to stage land development.

Action 15: Counties and cities enact planning and zoning regulations to stage land development consistent with the scheduling of urban services (including but not limited to "development sequence zoning", "tiered zoning districts", development timing permits etc.).

Action 16: Caltrans, MTC, counties, cities, and special districts plan, program, fund and construct highway, street, road and transit improvements consistent with local action to stage land development.

Policy F: Increase housing and job opportunities in existing urbanized areas by encouraging public and private rebuilding into compatibly mixed commercial, industrial and residential land uses.

Action 17: Counties and cities initiate and/or expand housing conservation programs in existing urbanized areas.

Action 18: Counties and cities initiate and/or expand commercial and industrial development and redevelopment in existing urbanized areas.

Action 19: Counties, cities and special districts initiate and/or expand incentives to public and private redevelopment in urbanized areas. Emphasis would be on sewer and water facilities, and extensive transit service improvements, but should also include educational and cultural facilities and public safety service improvements where appropriate.

Action 20: ABAG, counties and cities analyze possible local revenue reforms to provide adequate financial resources to carry out Action 19.

Action 21: ABAG support State legislation to provide local governments with adequate fiscal resources to carry out Action 19.

Action 22: ABAG oppose Federal and State legislation that would hamper the ability of local governments to carry out rebuilding programs to increase job and housing opportunities in existing urbanized areas.

Policy G: Encourage "infill" development of bypassed vacant land within urban service areas.

Action 23: Counties and cities undertake planning studies to inventory bypassed land, identify development problems, and resolve questions of best potential use.

Action 24: Counties and cities adopt necessary changes in zoning and permit procedures to facilitate development of bypassed parcels affected by special conditions.

Action 25: Service agencies design sewer, water and transportation systems to improve accessibility and service ability of bypassed vacant land in existing urban communities.

Policy H: Develop at higher densities within service areas where existing or committed urban service capacities, including transit, can support the higher densities.

Action 26: In urban service areas with adequate sewer, water and transit capacities, counties and cities rezone appropriate locations to permit higher densities.

Action 27: Counties and cities enact ordinances (such as those for planned unit development or cluster zoning) to foster higher densities on appropriate sites.

Policy I: Limit development of land within urban service areas where soil, slope, or other conditions can support only low-density development.

Action 28: Counties, cities and special districts deny primary urban services to these locations by excluding them from capital improvement programs and design of service systems, and by enactment of hookup moratoria, etc.

Action 29: Counties, cities, and special districts establish programs of public land management (including but not limited to public land acquisition, purchase/transfer of development rights, purchase/leaseback, etc.) to maintain appropriate sites in open uses.

Policy J: Improve the balance of jobs and housing in jurisdictions throughout the region to reduce the necessity for long distance home-to-job travel.

Action 30: Cities and counties adopt programs to increase local employment opportunities if a substantial proportion of their residents work elsewhere.

Action 31: Cities and counties adopt programs to increase local housing opportunities in a price range suitable for their work forces if a substantial proportion of their work forces live elsewhere.

Action 32: ABAG conduct A-95 and EIR reviews to support local government efforts to improve the balance of jobs and housing in communities throughout the region.

Action 33: ABAG support State and Federal funding allocations for facilities and programs offering incentives to economic development or housing development in appropriate jurisdictions.

Policy K: Mix residential/commercial and industrial development in communities throughout the Bay Region.

Action 34: Counties and cities revise zoning ordinances to allow compatible mixtures of land uses with adequate design or performance standards (including planned unit developments, performance standard zoning, etc.).

Action 35: Counties and cities expand application of conditional use permits where appropriate.

Policy L: Discourage new large-scale land development projects that are exclusively commercial, industrial or residential, unless such projects clearly demonstrate that they improve the overall balance of jobs and housing in that city, county, or subregion.

Action 36: Counties, cities and LAFCOs deny incorporation or annexation of large-scale development proposals that are exclusively commercial, industrial or residential, unless such incorporation or annexation can be shown to improve the overall balance of jobs and housing in the city, county, or subregion.

Action 37: MTC, the California Department of Transportation and transportation districts deny regional transportation system access or extension to proposed large-scale land development projects that are exclusively commercial, industrial or residential unless such transportation actions can be shown to improve the overall balance of jobs and housing in the city, county or subregion.

Policy M: Fund new wastewater and transportation facilities only after areas serviced have taken actions recommended in the plan.

Action 38: The State Water Resources Control Board and the Environmental Protection Agency require applicants for wastewater facilities under Section 201 of the Federal Water Pollution Control Act to demonstrate, prior to construction funding, that specific actions (including but not limited to land development regulations, urban service commitments, etc.) have been taken by affected jurisdictions to carry out actions of this plan.

Action 39: The U.S. Department of Transportation, the California Transportation Commission, the California Department of Transportation and the Metropolitan Transportation Commission require applicants for transportation improvement grants to demonstrate, prior to funding for acquisition and construction that specific actions (including but not limited to land development regulations, urban service commitments, etc.) have been taken by affected jurisdictions to carry out actions of this plan.

Policy N: Review development proposals for air quality effects and consistency with compact development (indirect source review).

Indirect sources of air pollution are sources that do not directly emit pollutants, but which include emissions from other sources (primarily motor vehicles). An Indirect Source Review program would be used for two purposes: First, to ensure consistent application of the compact development policies; and second to prevent localized carbon monoxide problems in the vicinity of the indirect source.

The types of new or modified sources to be reviewed for approval under this measure would include, but would not be limited to, the following:

- Highways and roads;
- Parking facilities;

- Retail, commercial, and industrial facilities;
- Recreation, amusement, sports, and entertainment facilities;
- Airports;
- Office and government buildings;
- Apartment and condominium buildings;
- Education facilities.

The above sources would include most large projects.

The review procedure would be limited, however, to developments above certain size thresholds, specified in terms of daily traffic volumes for highways, annual aircraft operations for airports, and number of parking spaces for most other facilities. Indirect sources smaller than the threshold sizes are assumed to be evaluated and controlled as part of the overall compact development strategy.

Action 40: ABAG, BAAPCD and MTC adopt memoranda of understanding and procedures for prompt and thorough joint review of significant development proposals. Review would be conducted for proposals (such as shopping centers, industrial parks, office complexes, etc.) where significant air pollution could result from the project's generation of auto traffic.

Action 41: BAAPCD adopt permit procedures for application to indirect sources.

Action 42: ABAG encourage and support local government efforts to determine direct and indirect effects on air quality in making local land use decisions. Such support shall include technical assistance and analysis.

Action 43: ABAG and MTC encourage and support local government efforts to reduce adverse effects of development proposals on air quality, including but not limited to assistance in identifying and implementing mitigation measures for adverse impacts of municipal wastewater facilities and transportation improvement programs.

Policy 0: Adopt financial programs to support local and regional agency actions and private sector development actions consistent with policies in this chapter to reduce home-to-work distance and auto dependency.

Action 44: ABAG, counties and cities support State and Federal legislation to provide subventions and other fiscal assistance to cities and counties carrying out development policies to achieve air quality standards.

Action 45: ABAG, counties and cities support State and Federal legislation providing tax incentives to the private sector for rebuilding and development within existing urbanized areas.

Action 46: ABAG, counties and cities support State and Federal legislation providing financial support to local and regional agencies for carrying out development management policies and reviews to achieve air quality standards, especially to mitigate adverse impacts on low- and moderate-income households.

Policy P: Adopt a coordinated regionwide program for carrying out actions for attainment and maintenance of air quality standards through development and land use management actions by cities, counties, special districts, ABAG, BAAPCD, MTC, LAFCOs and other appropriate local and regional agencies.

Action 47: ABAG identify, within six months of General Assembly adoption of an initial air quality maintenance plan, which implementing actions are being carried out by local and regional agencies.

Action 48: ABAG include, in each annual revision of the AQMP, agreements reached among local and regional agencies for carrying out land use and development management actions included in the initial AQMP.

Action 49: ABAG shall include, in each annual revision of the AQMP, an identification of actions not being carried out by all appropriate agencies, and which actions are to be carried out by appropriate agencies by the next annual revision of the AQMP.

PROCEDURE FOR MODIFYING DRAFT AQMP PROPOSALS

The draft AQMP proposals, if implemented, demonstrate attainment and maintenance of the oxidant standard. The thrust of the program is twofold:

- 1) Implementation of a comprehensive strategy requiring additional technological controls on stationary and mobile sources, transportation controls and land use management programs, and
- 2) Continuation of the BAAPCD's review of new or modified sources (New Source Review rule) and implementation of an indirect source review program for major traffic generators (e.g. shopping centers, airports, sports facilities). New Source Review could continue in its present form or in a modified form to allow for emission off-sets.

The New Source Review (NSR) and Indirect Source Review (ISR) programs are used to make up the difference between the emission reductions occurring from other programs and what remains to be done to meet the standard in 1985, and to maintain it thereafter. Figure 27 in Section 6 showed the relative role played by the different programs to demonstrate attainment and maintenance of the standard.

Two general types of changes can be made to modify the plan:

- 1) Addition, deletion or substitution of measures proposed in the Comprehensive Strategy.
- 2) Addition, deletion, or substitution of measures for the New Source Review and Indirect Source Review programs.

Some combination of these approaches is also possible. However, in considering modifications to the draft AQMP proposals, the major factor is whether or not the new proposals suggested would demonstrate numerically that the standard can be met by 1985-87 and maintained thereafter. This demonstration is

required by Federal regulations. It should not be assumed, however, that eliminating measures from the Comprehensive Strategy can be readily compensated for by applying the new and indirect source review programs more stringently. There are limits to the effectiveness of those programs, and if they are applied in strict form they will reduce the region's ability to achieve other important social and economic objectives.

To demonstrate how the draft AQMP proposals might be modified, two examples are provided below:

Example 1: Change the Comprehensive Strategy to delete the increased tolls and regional parking strategies

Option A: Substitute increased gas taxes and smog charges to make up the difference in emission reductions needed; or

Option B: Recommend modification to the New Source Review rule to require additional off-sets from new and existing industries. For example, instead of a 1.2 to 1.0 off-set in emissions, a 1.4 to 1.0 off-set in emissions might be required of new industries.

Example 2: Change the Comprehensive Strategy to delete all land use and transportation control proposals

Option A: Recommend substituting a ban on small gasoline engines (e.g. such as lawn mowers and chain saws) and catalytic converter retrofit program to make up the difference in emission reductions needed; or

Option B: Recommend substituting a limited gasoline rationing program to make up the difference in emission reductions needed.

As the EMTF, ABAG Executive Board and the public review the draft AQMP proposals and develop options for consideration, two factors are important:

- 1) The plan is required to demonstrate the standard being met by 1985-87 and maintained thereafter,
- 2) The plan should provide flexibility to account for more monitoring data which may suggest the need for more or less stringent programs.

Section-8

IMPLEMENTATION OF THE PLAN

Section 7 identified a wide range of air quality measures needed to meet and maintain the oxidant standard. An overall implementation schedule for each measure was also presented. This section further details how the plan would be carried out. It describes the roles of different implementing agencies, requirements for new legislation, and requirements set forth by the Clean Air Act of 1977.

IMPLEMENTING THE AQMP RECOMMENDATIONS

The authority to implement most of the AQMP recommendations currently exists among the various State, regional and local agencies. In a few instances, new legislation would be required to carry out a few of the proposals. However, to a large extent the plan recommendations build upon existing powers and proposes programs which extend these authorities.

Air pollution controls in the Bay Area have been the primary responsibility of the California Air Resources Board and the Bay Area Air Pollution Control District. In the plan, both agencies continue to have very important roles. These two agencies would be responsible for ensuring that best available control technologies for stationary and mobile sources are being used. This would apply to both new and existing sources in each case.

The plan also identifies important roles for State and regional agencies and local governments of the Bay Area. Both general and special purpose agencies would be involved. These agencies would be responsible for reducing the amount of automobile travel throughout the region. This would be accomplished by reducing both the length and number of automobile trips made.

Federal agencies also would play an important role in carrying out the AQMP. As in the past, the Environmental Protection Agency must continue to provide technical assistance. "Reasonably available" and "best available" control technologies will have to be precisely defined. Important oxidant control issues, such as long range transport and the precise role of nitrogen oxides in oxidant formation, need further research.

Federal agencies will also be needed to provide financial assistance. Such support is needed for further planning, monitoring activities, and in some cases to fund implementation of important programs. It is assumed under the Clean Air Act of 1977 that funds for planning and carrying out key air pollution control programs will continue to be granted to California and Bay Area governmental agencies. For example, the Clean Air Act of 1977 may be able to assist states financially in implementing inspection and maintenance programs. Also, if the Bay Area is to significantly improve and expand its transit service, the U.S. Department of Transportation would have to provide additional funds to subsidize operation and maintenance expenses. Other grants would be required to fund the capital costs of the buses themselves.

Stationary Source Controls -- The Role of the Bay Area Air Pollution Control District

Two basic programs would be carried out by the Bay Area Air Pollution Control District. These programs are:

- Use of best available control technology (BACT) for new and existing industries
- A review (and permit program) for new and modified air pollution sources to ensure use of BACT and a determination of the source's contribution to further violations of air quality standards. The District, as previously noted, has had some form of new source review rule in effect since 1972, and is currently reviewing the rule to consider options which would permit emission off-sets.

The Bay Area Air Pollution Control District has the authority to adopt a BACT rule after public hearings. Adoption of such a regulation requiring industry to use specific control technologies would warrant careful thought and extensive public hearings. The most probable form of such a rule would incorporate best available control technology into a permit system, and would work from a catalog listing the best available control methods or equipment in any particular situation. Possibly there would be some flexibility in what methods or equipment would be required to accommodate the wide variety of sizes, forms, design and operations to be found in the many industries affected. The catalog would be regularly reviewed and updated, with a continuing critique provided by the District's Advisory Council.

A best available control technology rule could supercede performance standards or be applied in conjunction with performance standards. Minimum performance levels could be used to prevent deterioration of the best available control technology after installation. In some cases, existing performance standards in effect require use of best available control technology.

Implementation of a best available control technology rule would require an increase in the District's engineering staff and probably Legal and Hearing Board staff. An additional ten engineers would be needed to carry out the work required by such a rule. It is also expected that the District's Hearing Board activities would increase as a result of such a rule.

A best available control technology rule could be adopted by the end of 1979. Five years should be allowed for full implementation. This regulation would cover a wide range of operations within the Bay Area. The rule itself is likely to be controversial and therefore subject to some delays as it is being adopted. Many establishments, for example, may have recently incurred expenses for control equipment that may now be declared obsolete. In the adoption process, the District's Board of Directors could consider exemptions and extended time schedules for classes of industries or small operations. After the rule had been adopted, individual appeals could be made to the District's Hearing Board for variances from the regulation where justified.

The AQMP assumes continued application of a New Source Review rule for new and modified industrial or commercial facilities. The Bay Area Air Pollution Control District is currently reviewing a series of alternatives which would permit emission off-sets. Any or all of these suggested changes to the present rule could be adopted within six months. This period would allow time for public hearings and the BAAPCD Board of Directors to consider the changes to be adopted. In any event, the use of New Source Review as it presently stands or as modified to permit emission off-sets is key to the Bay Area's demonstration of meeting and maintaining the oxidant standard.

Mobile Source Controls - The Role of the California Air Resources Board

Three programs are recommended for implementation by the California Air Resources Board. These control programs are:

- Adoption of more stringent light and heavy duty exhaust emission standards
- Implementation of an inspection and maintenance program for light and heavy duty vehicles
- Implementation of a heavy duty gasoline exhaust retrofit device for in-use heavy duty gasoline vehicles.

The requirement for carrying out these programs are different in each case. These differences are described briefly below.

Section 209(b) of the 1977 Clean Air Act permits California upon request to the Environmental Protection Agency to obtain a waiver from the Federal auto exhaust emission standards. Such a waiver would allow California to adopt more stringent automotive exhaust emission standards. A similar provision was also in the 1970 Clean Air Act because of the particularly severe air pollution problems in California and the need for more stringent controls. The California Air Resources Board has been successful in obtaining such a waiver for adoption of stricter standards. Under the plan recommendation, the California Air Resources Board would again exercise its authority to implement tighter exhaust emission standards than the rest of the country.

Under the 1970 Clean Air Act, only California was permitted to adopt more stringent standards. The 1977 Clean Air Act now permits other states to adopt California's standards where such standards are more stringent than the Federal standards. This provision of the 1977 Act reinforces the importance of California's role in leading the country for requiring the most stringent standards achievable by the automotive industry. In fact, under the 1977 Act, the California Air Resources Board and the Environmental Protection Agency need to work closely to set exhaust emission standards that are stringent, but technologically achievable. Clearly, if the Federal government requires tighter controls than those identified in the 1977 Clean Air Act, it will be much easier for California to follow suit. Even without such action, however, it appears

quite plausible that a further tightening of light and heavy duty exhaust emission standards for vehicles manufactured after 1990 is possible. Because of the implementation schedule assumed for this measure, the tighter exhaust standards is strictly a maintenance measure. This program would be needed to partially offset the large growth in travel projected for the region by the year 2000.

A vehicle inspection and maintenance program for the Bay Area would require State legislation to be implemented. This program would be carried out by the California Air Resources Board and/or the State Department of Consumer Affairs, Bureau of Automotive Repair. The Clean Air Act of 1977 requires that a specific schedule for implementation of a vehicle inspection and maintenance program be included before any time extensions beyond 1982 are allowed for meeting the oxidant standard. It has been assumed that the 1977 Act requirements will be the primary moving force to getting inspection and maintenance implemented in the Bay Area. This program is important for meeting the oxidant standard by 1985-87 and long term maintenance of the standard thereafter.

Implementation of a heavy duty retrofit program would require new State legislation. Such legislation would include the California Air Resources Board to be designated the appropriate implementing agency for the program. To achieve maximum effectiveness from this program, two factors are important:

- The measure would have to be implemented as soon as possible (and no later than 1985). As older vehicles are replaced the need and effectiveness of this control program diminishes.
- The measure would have to be implemented on a Statewide basis. This would prevent vehicles from being registered outside the Bay Area and thus exempt from the control. This would not solve the problem of vehicles registered outside the State. Since many heavy duty vehicles provide inter-state transport, the enforcement aspects of this program could pose some problems.

The heavy duty vehicle retrofit program would be implemented in two stages. The first stage would be to retrofit all 1971-76 model year vehicles by 1980. The second stage would be to require all 1977-82 heavy duty vehicles to be retrofitted by 1985. This program is primarily an attainment measure. Because of the nature of retrofit programs, only short term benefits are gained. Nonetheless, this program is an important part of the comprehensive strategy set forth in the plan.

Transportation Controls - The Role of the Metropolitan Transportation Commission and Others

The Metropolitan Transportation Commission is responsible for preparing the transportation plan for the region. Once the AQMP is adopted, it would be necessary for the Metropolitan Transportation Commission to adopt the transportation control measures in the AQMP as part of the Regional Transportation Plan. In addition, it would be necessary for MTC to coordinate the development of an implementation program for each control measure.

There are two control measures which generate revenues to support transit service improvements: The toll increase on all trans-bay bridges, and the regional parking tax. The Metropolitan Transportation Commission has the authority to raise tolls on all bridges except the Golden Gate Bridge, for which tolls are set by the Golden Gate Bridge Highway and Transportation District. The parking tax would be implemented by cities and counties regionwide through existing municipal agencies that now monitor parking operations. Cities have the authority to levy such a tax in the form of a business license tax, based on revenue.

As previously stated, the revenue-generating control measures would be used to generate funds for transit and other transportation improvements in the region. The Metropolitan Transportation Commission would assist in the development of new transit service by allocating the funds to transit operators. Actual implementation of the service improvements would be the responsibility of the individual transit districts, and would be programmed to take place over a five year period beginning in 1980.

Implementation of incentives to the use of high occupancy vehicles (e.g., carpools) would be the primary responsibility of the California Department of Transportation. Caltrans would implement the bus and carpool lanes and ramp metering measure relying primarily on federal funds, and would expand its current program of leasing lots underneath freeways and other locations to provide preferential parking for carpools. Carpool matching and data services currently provided by Caltrans will be taken over and expanded by a recently formed non-profit corporation. Finally, to encourage employers to set aside preferential parking for carpools, the Metropolitan Transportation Commission would provide planning assistance and publicity to participating employers.

Implementation of incentives to the use of non-motor vehicle forms of transportation (i.e., bicycling and walking) would primarily be the responsibility of cities and counties, with State and federal funding assistance.

Bicycle systems are an acknowledged part of the Regional Transportation Plan. Local planners would design facilities, map routes and locations, and estimate costs, while the Metropolitan Transportation Commission would assemble the local plans into a regional plan to aid in securing State and federal construction grants. The proposal to implement an auto controlled zone in the San Francisco Central Business District has already been adopted as part of the transportation element of San Francisco's Master Plan. The City of San Francisco has the authority to restrict parking and close streets to vehicular traffic.

Development Controls and Land Use Management -- The Role of Local and Regional Agencies

Currently, local governments have no direct responsibilities for controlling air pollution. They are responsible, however, for guiding location and development of new urban growth which contributes to the region's air quality problems. The manner in which local governments manage future growth will be an important factor in meeting and maintaining air quality standards.

The previous section describing the plan summarized the regional development issues and the need to reduce vehicle travel throughout the region. Sixteen policies and forty-eight actions were identified for governmental agencies to consider and act upon to bring about more compact development in the region. Local and regional governments have the authority to carry out all the actions identified.

The state empowers its special subdivisions -- cities, counties, special districts and regional agencies -- to perform four functions. These functions are regulation, acquisition, development and taxation. Each of these functions is needed in varying degrees and their use affects the public at large, private businesses and public agencies. What the plan requires is local governments using these powers to achieve regional air quality goals.

One program is recommended to ensure development consistent with air quality objectives. It is the implementation of a regional Indirect Source Review program. This program would review all major developments which attract large volumes of automobile traffic. Two reviews would be conducted. A localized review for carbon monoxide problems would be conducted around the immediate area of the proposed development. Secondly, a review of the project for consistency with compact development policies would be conducted. The reviews would be conducted jointly by the Bay Area Air Pollution Control District, Metropolitan Transportation Commission and Association of Bay Area Governments.

REQUIREMENTS OF THE CLEAN AIR ACT OF 1977

The current AQMP planning effort was more than a year old when the Clean Air Act of 1977 was signed into law. The 1977 Act sets forth specific requirements for "non-attainment plans". Key requirements are cited below, along with brief discussions of how the requirements relate to the AQMP presented. In particular, the plan provisions required by Section 172(a) relating to actions needed prior to any major construction after July 1, 1979 are:

- (1) "be adopted by the state" -- this plan has been written for inclusion in a State Implementation Plan.
- (2) "implementation of all reasonably available control measures" -- although subject to some interpretation, this plan proposes all reasonably available control measures for implementation.
- (3) "require, in the interim, reasonable further progress: -- if carried out as proposed, this plan would demonstrate reasonable and steady progress toward the oxidant standard.
- (4) "include a comprehensive, accurate, current inventory of actual emissions from all sources" -- this plan contains such an inventory.
- (5) "identify and quantify the emissions...allowed...from major new...sources" -- such an analysis is shown in Figure 27 -- Section 6.

- (6) "require permits for...new or modified...sources" -- this plan recommends continuation of the New Source Review rule being implemented by the Bay Area Air Pollution Control District.
- (7) "identify and commit the financial and manpower resources necessary to carry out the plan" -- the financial and manpower resources needed to carry out the plan have been identified; commitments can only come after the plan has been adopted and approved by the many agencies responsible for carrying it out.
- (8) "emission limitations, schedules of compliance" -- emission limitations to meet the standard and an implementation schedule have been prepared in this plan.
- (9) "evidence public, local government, and State legislative involvement" -- these requirements have been partially met during the plan preparation and will be fully met as the plan is publicly reviewed over the next six months.
- (10) "evidence...the necessary requirements...to implement and enforce...the plan" -- this section described requirements for implementing the plan, including as necessary identification of new legislation required. Considerable work remains for the continuing planning process to secure all the needed agreements, regulations, ordinances, and statutes necessary to implement and enforce the plan as proposed.

The Clean Air Act of 1977 provides for time extensions beyond 1982 for areas with severe oxidant and/or carbon monoxide problems. The analysis shown in Section 6 and the implementation time schedules described in this section provide a sound basis for formally requesting a time extension for photochemical oxidants.

Section-9

BENEFITS AND COSTS OF THE PLAN

This section summarizes the benefits and costs of the Air Quality Maintenance Plan. As mentioned previously, this plan emphasizes the control of emissions that form photochemical oxidants, the most serious air quality problem in the region. Reducing the concentration of photochemical oxidants has three types of benefits:

- Improvements in public health
- Reduction in damage to vegetation
- Reduction in damage to other materials

The controls required to achieve these benefits will cost money. These direct costs are also summarized in this section. Other effects accompanying the controls have been described in Section 7 of this chapter as well as Chapter II.

This section summarizes the latest information on effects. Like other investigations of this nature, there are limitations and uncertainties in the available data. The adverse effects described herein would be significantly reduced or eliminated as this plan is carried out. These improvements constitute, therefore, the benefits of carrying out the plan.

THE BENEFITS OF CLEANER AIR

Air pollution can have deleterious effects--sometimes very serious effects--on health. Pollution can also damage or destroy plant life and other materials. These adverse effects are set forth below.

Effects on Human Health

Photochemical oxidants have been found to cause eye irritation, nasal irritation, irritation of mucous membranes, respiratory distress and difficult breathing, increased fluid in the lungs, coughing, rapid pulse rate, lowered blood pressure, asthma attacks, and overall decrease in the quality of human performance.

Some of these effects have been observed at relatively low oxidant levels. In other cases, short-term exposure to relatively high oxidant or ozone levels has produced few if any negative effects. There are two reasons for such variable results. One is that pollution combines with many other factors to affect health. For example, under certain conditions, even low oxidant levels can be harmful. The other reason is that each individual responds differently to oxidant exposure. Thus, the Federal standards for oxidant levels have been set to protect sensitive population groups--and that includes most people at one time or another--children, the elderly, and the chronically or temporarily ill.

A large number of statistical studies, clinical analyses of specific case histories, and controlled experiments have been conducted to determine the effects of photochemical oxidant or ozone exposure. Effects from short-term exposure to high pollutant levels are more easily observed than are effects from long-term exposure to more moderate levels. Following is a brief summary of effects observed in some of these studies. As described in Section 4, high levels of oxidant in the region frequently reach 2-3 times (.16 - .24 ppm) the 0.08 ppm standard, depending on meteorological conditions.

- In several American studies, eye irritation has been observed at daily maximum hourly concentrations ranging from about 0.1 ppm to about 0.15 ppm. Recent Japanese studies raise the possibility that even lower oxidant concentrations may contribute to eye irritation under certain conditions. Such values, as previously shown, are quite typical of levels reached in the Bay Area. The consistency of the association between short-term oxidant exposures and eye irritation arouses concern about the long-term effects of such exposures.
- Several studies have noted a gradual decrease in human athletic performance under short-term exposures to photochemical oxidant. Investigators observed that high-school cross country runners did not perform as well when hourly concentrations increased from about .03 to .30 ppm. Best performances were almost always on days of low oxidant concentrations. Other similar studies suggest that on high-oxidant days, the irritant effects of pollutants may have restricted the runners' mechanical lung function sufficiently to prevent them from taking in enough oxygen to support their potential performance levels.
- Respiratory distress in healthy people, especially children, has been frequently noted. Symptoms observed in school children, including sore throat, headache, cough and difficult breathing, were higher on days when maximum hourly oxidant levels equalled or exceeded .15 ppm than on days when concentrations were below .10 ppm.
- Short-term oxidant exposure has also been associated with aggravation of existing disease. Thus, individuals with existing respiratory ailments are more likely to be affected by oxidant pollution.
- Investigators have observed a significantly higher rate of asthma attacks on days when oxidant concentrations exceeded .25 ppm.
- A 1973 study measured significant impairment in lung function in 10 normal male subjects aged 23-53 years (including two smokers) exposed to pure ozone at 0.75 ppm for 2 hours. Two of the three subjects who exercised intermittently showed accentuated effects. In other similar experiments, most subjects complained of cough, chest tightness, and soreness. A few also had pharyngitis, difficult breathing and wheezing.
- Some limited studies have shown evidence of human health effects from ozone at concentrations of 0.25 ppm and preliminary findings of a 1976 study suggests lowered lung function at 0.1 ppm exposure for 2 hours.

Additional studies on occupational exposure to ozone are summarized in Table 22. It is evident from the table that a wide range of responses has been observed. Investigators recognize that short-term exposure to high pollutant levels can indicate the potential for serious problems from long-term exposure to moderate or low levels. While specific effects may not be the same in both cases, controlled experiments and clinical appraisals show that exposure to oxidant and ozone concentrations could have serious health effects. Results from a number of controlled human exposure to ozone studies are given in Table 23.

Effects on Vegetation

Oxidant injury to vegetation was first identified in 1944 in the Los Angeles basin. The understanding of oxidant effects and of the widespread nature of their occurrence has increased steadily since then. Observed effects on plant life include visible foliar injury and discoloration, increased leaf drop, reduced plant vigor, reduced plant growth, and death.

Biological effects occur not only in individual plants but also in plant communities and entire ecosystems. The implications of oxidant exposure to agricultural crops are dramatic.

- Field experiments compared yields of crops grown in clean air and air with typical ozone concentrations. These experiments showed up to 50% decreases in citrus yield; 10%-15% suppression in grape yield in the first year and 50%-60% reduction over the following two years; and a 5%-29% decrease in yield of cotton lint and seed in California.
- Losses of 50% in some sensitive potato, tobacco and soybean cultivars have been reported in the eastern United States.
- Reductions in yield, with little accompanying injury, have been noted for several crops. Severe injury was required to cause reduction in tomato yield. Chronic exposures to ozone at .05 to .15 ppm for 4 to 6 hours per day produced reductions in yield in soybean and corn grown under field conditions. The threshold concentration for ozone appears to be between .05 and .10 ppm for sensitive plant cultivars.
- Adverse effects of short-term exposure to ozone have been noted at the following levels and durations:

Trees and shrubs:	.2 to .51 ppm for 1 hour duration
	.2 to .25 ppm for 2 hours duration
	.06 to .17 ppm for 4 hours duration
Agricultural crops:	.2 to .41 ppm for .5 hour duration
	.1 to .25 ppm for 1 hour duration
	.04 to .09 ppm for 4 hours duration

Table 22. SUMMARY OF SELECTED DATA ON OCCUPATIONAL EXPOSURE OF HUMANS TO OZONE

Ozone, ppm	Subjective complaints	Clinical findings attributed to ozone	Measurements of pulmonary function	Other comments
0.25	None	None	None	-
0.3 to 0.8	Chest constriction and throat irritation in 2 to 4 subjects	None	None	-
0.2	-	None	None	-
0.8 to 1.7	Dry mouth and throat, irritation of nose and eyes, disagreeable smell in 11 of 14 subjects	None	None	Concentration of trichloroethylene up to 238 ppm found
0.2 to 0.3	Irritating odor, soreness of eyes, and dryness of mouth, throat, and trachea in 1 of 7 subjects	None	VC decrease in 3 of 7 subjects. FRC decreased in 2 of 7 subjects. DLCO decreased in 1 of 7 sub- jects.	All decreases in pulmonary function measurements were small. All sub- jects were smokers.
0.4	Discomfort and irritation in about 30 minutes	None	None	-
0.47	Distinct irritation of mucous membranes	None	None	-

Source: U.S. Environmental Protection Agency, "Air Quality Criteria for Photochemical Oxidants and Oxidant Precursors," Volumes I-II, DRAFT NO. 1, September 1977.

Table 23. SUMMARY OF SELECTED DATA ON HUMAN EXPERIMENTAL EXPOSURE TO OZONE

Ozone, ppm	Length of exposure	No. and sex of subjects	Subjective complaints	Measurements of pulmonary function	Other comments
0.2	3 hr/day 6 days/wk, for 12 wk	6 male	None	VC: no change FEV _{1.0} : no change	0.66 upper respir- atory infections/ person in 12 weeks. Control group had 0.95 in the same period
0.5	3 hr/day 6 days/wk, for 12 wk	6 male	No irri- tating sym- toms but could de- tect ozone by smell	VC: slight decrease but not significant decrease toward end of 12 weeks. Returned to normal within 6 weeks after exposure.	0.80 upper respir- atory infections/ person in 12 weeks
0.1	1 hour	4 male		Airway resistance: mean increase 3.3% at 0 hours after exposure (1/4 sub- jects showed an in- crease of 45%)	One subject had history of asthma, and experi- enced hemoptysis 2 days after 1 ppm
0.4	1 hour	4 male	Odor	Airway resistance: mean increase 3.5% at 0 hours after exposure (1/4 sub- jects showed an in- crease 12.5% 1 hour after exposure	

Table 23. (Continued) SUMMARY OF SELECTED DATA ON HUMAN EXPERIMENTAL EXPOSURE TO OZONE

Ozone, ppm	Length of exposure	No. and sex of subjects	Subjective complaints	Measurements of pulmonary function	Other comments
0.6	1 hour	4 male	Odor	Airway resistance: mean increase 5.8% at 0 hour after ex- posure (1/4 subjects showed an increase of 75%), mean in- crease 5% 1 hour after exposure	

Source: U.S. Environmental Protection Agency, "Air Quality Criteria for Photochemical Oxidants and Oxidant Precursors," Volumes I-II, DRAFT NO. 1, September 1977.

- According to a 1975 report by the State Department of Food and Agriculture, certain crops are no longer grown in the Bay Area because of air pollution. Among these crops are snap dragons and chrysanthemums.
- In the Bay Area ornamental growers have relocated their greenhouses from San Francisco to Half Moon Bay. Similarly, rose growers have moved to Salinas to avoid air pollution damage.
- According to recent surveys by the State Department of Food and Agriculture, crops seriously damaged in the Bay Area are grapes, carnations, and orchids.
- Estimated loss to cut flower growers in the Bay Area in 1970 was approximately \$1 million.
- Estimates of total annual statewide agricultural damage from air pollution have ranged widely from tens of millions of dollars to almost a half billion dollars. While much of this damage occurs in the Los Angeles and San Joaquin Valley areas, a significant portion also occurs in the Bay Area.
- The available data would suggest annual agricultural damage in the Bay Area from oxidant air pollution may range from several million dollars upwards to tens of millions of dollars.

It is clear that trees, shrubs and agricultural crops are affected by the levels of oxidant air pollution which occur in the Bay Area. It can therefore be concluded that a reduction in oxidant levels can have a very significant beneficial effect on plant life.

Effects on Materials

Just as with humans or plant life, air pollution can have negative effects on man-made materials. Ozone can accelerate the aging of rubber products and can cause dye fading in clothes, carpeting and other textiles. It can reduce the life of industrial maintenance points and vinyl and acrylic coil coatings. Textile fibers can also be damaged by ozone, resulting in accelerated aging.

The cost of such materials damage takes two forms. There is the cost to the producer who must take preventive measures to protect the product from ozone damage. There is also the costs to consumers. The consumer pays for such damage through earlier replacement of materials. For example, one study estimated the national cost of ozone fading--e.g. nylon carpets, permanent-press garments, acetate and triacetate textiles--to be approximately \$80 million annually.

Figure 29 presents a summary of the estimated total annual per capita cost of ozone damage and preventive measures as a function of annual ozone concentrations. In 1974, the annual average ozone concentration in the Bay Area was between .015 and .025 ppm. Thus, Bay Area residents paid between \$10 and \$33 million as a result of ozone damage to materials that year. By the year 2000, all other factors being equal, that cost will have risen to between \$12 and \$39 million per year in 1975 dollars.

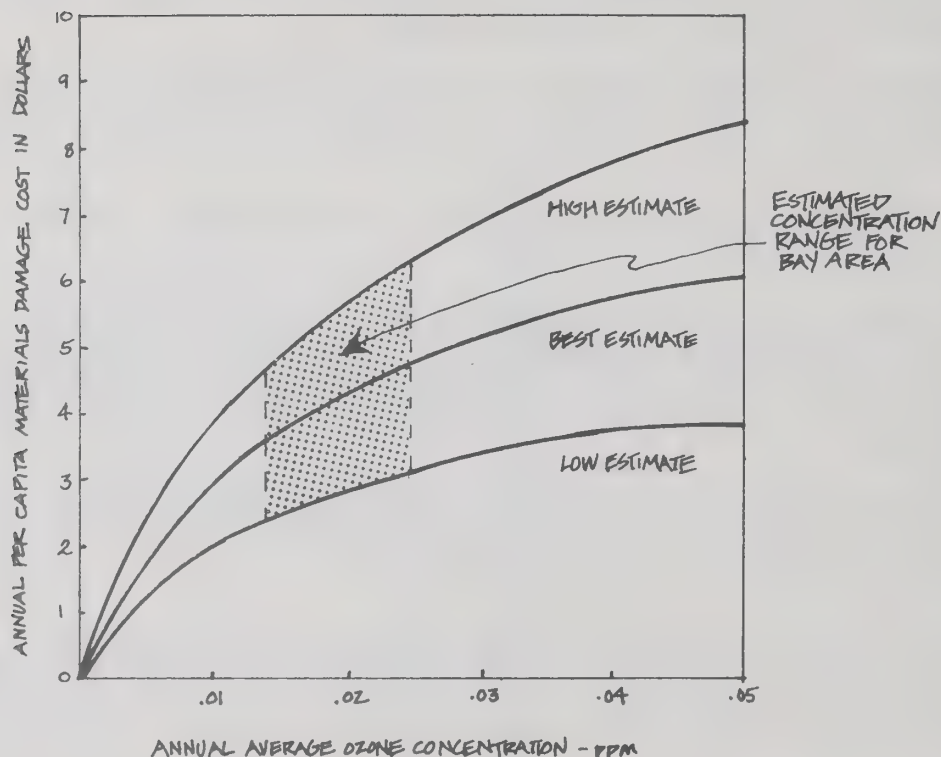


FIGURE 29.

EFFECT OF ANNUAL AVERAGE OZONE CONCENTRATION
ON ADDED COSTS DUE TO DAMAGE TO MATERIALS AND
PREVENTIVE MEASURES

The benefits to be realized from a significant reduction in oxidant levels may not always be quantifiable, but they are clear nevertheless. Air pollution has been found to have significant and negative effects on human health, plant life and materials. Maintenance of air quality standards thus plays a critical role in reducing the damages now experienced.

THE DIRECT COSTS OF THE PLAN

Section 7 of this chapter describes the AQMP proposals. A summary of the annualized costs for the control measures was also included. These costs have been broken down to capital, operation and maintenance, and administrative/regulatory costs. Several programs would generate revenues to offset the costs of other proposals. These have been noted. Details explaining how the annualized cost estimates were derived are given in Appendix B. This section briefly summarizes the direct costs needed to carry out the plan.

Stationary Source Control Costs

The major cost for additional stationary source controls would be for meeting best available control technology requirements. It is estimated this would cost about \$30 million annually. Most costs would be borne by private industry for capital outlays and higher operating and maintenance costs. An increase in public sector expenditures is also estimated for increased administrative and regulatory costs. These latter costs are estimated to be about two percent (or approximately \$600,000) of the costs of this program.

For private industry, slightly more than half of the costs are increased operating and maintenance expenses, which are recurring costs. The capital outlay requirements of approximately a half billion dollars would be expended in the early 1980's if the plan were carried out as scheduled.

No direct costs are associated with continued implementation of the New Source Review rule. Since this regulation has been in effect for a number of years, the administrative and regulatory costs are already budgeted for by the Bay Area Air Pollution Control District. Any of the options currently being considered to modify the New Source Review rule are estimated to cost about the same to carry out as the existing rule.

Mobile Source Control Costs

The annualized costs for additional mobile source controls is approximately \$50 million. These costs would pay for three very different programs. About half of the \$50 million is estimated to be the added per vehicle costs for cars and trucks which meet more stringent exhaust emission standards. The additional cost per vehicle would likely range between \$200 and \$400, assuming that a new engine technology is used to meet both the more stringent emission standards and Federal fuel economy standards. It has been assumed that these cars would be produced for all of California at a minimum, and possibly in a few other states with severe air pollution.

The vehicle inspection and maintenance program would cost about \$20 million annually. This cost includes a \$5 per vehicle inspection fee and an average repair cost of \$45 per vehicle, both paid by the vehicle owner. The \$5 inspection fee will cover the costs of acquiring land, constructing inspection facilities, equipment, and operation of the facilities. An additional aspect of the program would be that no vehicle owner would be required to spend more than a given amount (e.g., \$75) on repairs related to emission control.

The retrofit of heavy-duty gasoline powered trucks with exhaust catalysts is estimated to cost \$340 per vehicle, or a total annualized expenditure of \$1.5 million for the region. This cost includes a 50,000 mile replacement warranty. The slight increase in operating cost due to the use of unleaded gasoline will be offset by a slight improvement in fuel economy.

Land Use and Transportation Control Costs

Costs associated with the land use and transportation recommendations are more complex than the costs for stationary and motor vehicle emission controls. In many cases a redistribution of money within the region is the net result. For example, the cost of the bridge toll increase and the parking tax become revenues to support improvements in public transit systems. About \$18 million annually would be expended in this way. There are many hidden subsidies given to the use of the private automobile including a variety of public services (judicial system, coroner, fire department, on street parking, city planning, and other services typically financed from property taxes), and local ordinances which require parking to be provided by residential, commercial, and industrial developments. Because these subsidies are not structured on a "user pays" basis, there are existing inequities in the way transportation systems are financed. The use of bridge tolls and parking taxes to support transit service improvements could be viewed as a redistribution of subsidies from one transportation system to another. The land use recommendations support a more compact development pattern for the region than would occur under existing city and county land use policies. The direct cost of implementing these recommendations are of an administrative or regulatory nature. These costs will be estimated after the specific policies and actions to be implemented by each jurisdiction in the region are agreed upon. Indirect costs such as cost impacts on land, housing, commerce, etc. are addressed in the overall assessment.

The costs associated with the carpool incentive programs (preferential parking, bus/carpool lanes on freeways with ramp metering, and an expanded carpool matching program) total about \$9 million annually. The bulk of these costs are due to construction requirements for the bus/carpool lanes and ramp meters.

Finally, the cost of implementing a comprehensive system of bicycle paths and storage facilities is estimated to be approximately one-half million dollars per year. It was assumed that the paths would be striped onto existing roadways where the additional road width required would be accommodated by narrowing existing vehicle lanes.

Cost-Effectiveness of AQMP Recommendations

The cost-effectiveness of the various AQMP recommendations can be generally estimated in terms of the cost per ton of hydrocarbon emissions prevented, as summarized below:

THE DIRECT COSTS OF THE PLAN

Section 7 of this chapter describes the AQMP proposals. A summary of the annualized costs for the control measures was also included. These costs have been broken down to capital, operation and maintenance, and administrative/regulatory costs. Several programs would generate revenues to offset the costs of other proposals. These have been noted. Details explaining how the annualized cost estimates were derived are given in Appendix B. This section briefly summarizes the direct costs needed to carry out the plan.

Stationary Source Control Costs

The major cost for additional stationary source controls would be for meeting best available control technology requirements. It is estimated this would cost about \$30 million annually. Most costs would be borne by private industry for capital outlays and higher operating and maintenance costs. An increase in public sector expenditures is also estimated for increased administrative and regulatory costs. These latter costs are estimated to be about two percent (or approximately \$600,000) of the costs of this program.

For private industry, slightly more than half of the costs are increased operating and maintenance expenses, which are recurring costs. The capital outlay requirements of approximately a half billion dollars would be expended in the early 1980's if the plan were carried out as scheduled.

No direct costs are associated with continued implementation of the New Source Review rule. Since this regulation has been in effect for a number of years, the administrative and regulatory costs are already budgeted for by the Bay Area Air Pollution Control District. Any of the options currently being considered to modify the New Source Review rule are estimated to cost about the same to carry out as the existing rule.

Mobile Source Control Costs

The annualized costs for additional mobile source controls is approximately \$50 million. These costs would pay for three very different programs. About half of the \$50 million is estimated to be the added per vehicle costs for cars and trucks which meet more stringent exhaust emission standards. The additional cost per vehicle would likely range between \$200 and \$400, assuming that a new engine technology is used to meet both the more stringent emission standards and Federal fuel economy standards. It has been assumed that these cars would be produced for all of California at a minimum, and possibly in a few other states with severe air pollution.

The vehicle inspection and maintenance program would cost about \$20 million annually. This cost includes a \$5 per vehicle inspection fee and an average repair cost of \$45 per vehicle, both paid by the vehicle owner. The \$5 inspection fee will cover the costs of acquiring land, constructing inspection facilities, equipment, and operation of the facilities. An additional aspect of the program would be that no vehicle owner would be required to spend more than a given amount (e.g., \$75) on repairs related to emission control.

The retrofit of heavy-duty gasoline powered trucks with exhaust catalysts is estimated to cost \$340 per vehicle, or a total annualized expenditure of \$1.5 million for the region. This cost includes a 50,000 mile replacement warranty. The slight increase in operating cost due to the use of unleaded gasoline will be offset by a slight improvement in fuel economy.

Land Use and Transportation Control Costs

Costs associated with the land use and transportation recommendations are more complex than the costs for stationary and motor vehicle emission controls. In many cases a redistribution of money within the region is the net result. For example, the cost of the bridge toll increase and the parking tax become revenues to support improvements in public transit systems. About \$18 million annually would be expended in this way. There are many hidden subsidies given to the use of the private automobile including a variety of public services (judicial system, coroner, fire department, on street parking, city planning, and other services typically financed from property taxes), and local ordinances which require parking to be provided by residential, commercial, and industrial developments. Because these subsidies are not structured on a "user pays" basis, there are existing inequities in the way transportation systems are financed. The use of bridge tolls and parking taxes to support transit service improvements could be viewed as a redistribution of subsidies from one transportation system to another. The land use recommendations support a more compact development pattern for the region than would occur under existing city and county land use policies. The direct cost of implementing these recommendations are of an administrative or regulatory nature. These costs will be estimated after the specific policies and actions to be implemented by each jurisdiction in the region are agreed upon. Indirect costs such as cost impacts on land, housing, commerce, etc. are addressed in the overall assessment.

The costs associated with the carpool incentive programs (preferential parking, bus/carpool lanes on freeways with ramp metering, and an expanded carpool matching program) total about \$9 million annually. The bulk of these costs are due to construction requirements for the bus/carpool lanes and ramp meters.

Finally, the cost of implementing a comprehensive system of bicycle paths and storage facilities is estimated to be approximately one-half million dollars per year. It was assumed that the paths would be striped onto existing roadways where the additional road width required would be accommodated by narrowing existing vehicle lanes.

Cost-Effectiveness of AQMP Recommendations

The cost-effectiveness of the various AQMP recommendations can be generally estimated in terms of the cost per ton of hydrocarbon emissions prevented, as summarized below:

- The stationary source control recommendations would cost between \$200 and \$1000 per ton of hydrocarbon emission reduced, depending on the cost assumptions employed.*
- The motor vehicle emission control recommendations would cost approximately \$1000 per ton of hydrocarbon emissions reduced;
- The land use and transportation recommendations would cost approximately \$10,000 per ton of hydrocarbon emissions reduced, assuming no net dollar costs or benefits due to the land use recommendations.

These estimates would indicate to some what the priority for implementation of the various recommendations should be. Stationary source controls are clearly the most cost-effective within the time frame of this plan. The land use and transportation recommendations would appear to be relatively expensive; however, this conclusion is also only valid during the time frame of this plan. The effectiveness of implementing the land use and transportation recommendations are expected to increase with time beyond the year 2000.

*According to the cost conventions used for all control measures and described in Appendix B, the cost-effectiveness of stationary source controls would range from \$200 to \$300 per ton. However, stationary source control costs are (1) heavily weighted toward capital outlays for control facilities, which (2) have a shorter useful lifetime than assumed for all control measures (10-15 years rather than 25 years). Using these latter assumptions, the cost-effectiveness would be approximately \$1000 per ton.

Section-10

FUTURE WORK AND RESEARCH NEEDS FOR THE CONTINUING PLANNING PROCESS

In developing this initial air quality plan a number of future tasks and research needs have been identified. As described in Chapter IX, the air quality plan would be updated annually as part of the updated Environmental Management Plan. The continuing planning process to be established in the region will provide the appropriate forum for doing this work. The work may be categorized as follows:

- Data collection needed to support additional control programs
- Additional air quality analyses to support additional control programs
- Control strategy development and assessment for carbon monoxide, oxides of nitrogen, total suspended particulates, sulfur dioxide, and other pollutants as necessary
- Monitoring implementation of the initial plan
- Development of a procedure for updating the plan

Requirements for additional data collection, air quality analysis, and control strategy development are summarized in Table 24 by pollutant.

IMPLEMENTING AND REFINING THE PHOTOCHEMICAL OXIDANT PLAN

A number of tasks must be pursued to ensure that the elements of the initial AQMP are being implemented. In addition to the specific actions identified for each governmental agency in the plan, the eventual programs implemented and their performance records must be monitored and related to what was called for in the plan. Certain programs may in practice turn out to be either more or less effective than what was estimated in the plan. If that should occur, the plan would need to be modified to account for the difference. In particular, the need for New Source Review and Indirect Source Review programs could be reevaluated accordingly.

With respect to the recommended Indirect Source Review program, a Memorandum of Understanding between the Bay Area Air Pollution Control District, the Metropolitan Transportation Commission, and the Association of Bay Area Governments should be executed to initiate that program.

In addition to tasks which follow-up on the initial AQMP, other technical tasks should be undertaken to address the impact of Bay Area pollution on other parts of the State. In particular, the feasibility of extending the LIRAQ modeling analysis to cover larger areas should be investigated along with other alternatives. If an appropriate analysis technique can be developed, the impacts of different levels of NO_x emissions in the Bay Area on other air basins should be tested. Once the role of Bay Area NO_x emissions on neighboring regions is identified, appropriate control measures can be developed if necessary.

TABLE 24. SUMMARY OF FUTURE WORK FOR THE CONTINUING PLANNING PROCESS

POLLUTANT	ADDITIONAL DATA COLLECTION	ADDITIONAL AIR QUALITY ANALYSES	CONTROL STRATEGY DEVELOPMENT	MONITORING IMPLEMENTATION AND COMPLIANCE
PHOTOCHEMICAL OXIDANT	Meteorological and emissions data for long range transport analysis.	Long range transport analysis and testing of spatially variable controls.	As needed	<ul style="list-style-type: none"> o Plan update o Execute Memorandum of Understanding on Indirect Source Review o Monitor and evaluate implementation of other control programs.
CARBON MONOXIDE	<ul style="list-style-type: none"> o Meteorological data for a max. CO day o Motor vehicle emission factor revisions 	Detailed modeling of several localized CO "hot spots."	As needed	As needed
NITROGEN DIOXIDE	Meteorological data for a max. NO ₂ day	LIRAQ modeling analysis to test effectiveness of existing control programs.	As needed	As needed
TOTAL SUSPENDED PARTICULATES	Implement more sophisticated monitoring equipment and chemical analysis techniques.	Further refinement of the chemical mass balance technique.	As needed	As needed
SULFUR DIOXIDE	Meteorological data for worst case SO ₂ /Ox/particulate day.	Develop forecasting analysis techniques to address State standard.	As needed	As needed
OTHER STATE POLLUTANTS	<ul style="list-style-type: none"> o Establish continuous monitors for ethylene o Develop emission inventories for lead and ethylene 	<ul style="list-style-type: none"> o Develop a model for sulfates o Evaluate the effectiveness of existing controls on lead 	As needed	As needed

TASKS LEADING TO A CARBON MONOXIDE PLAN

The most critical ingredient to developing a carbon monoxide plan is to obtain policy agreement between the Environmental Protection Agency and the California Air Resources Board on future motor vehicle CO emission factors appropriate for use in California. A divergence of technical opinion exists at this time which affects whether or not a problem exists and whether controls need to be pursued in the Bay Area. Several of the control measures currently being recommended for oxidant control will contribute substantially to reducing CO problems in the region. The analysis of whether those measures are sufficient to meet and maintain CO standards depends on the resolution of the emission factor issue.

Once an appropriate set of emission factors is developed, detailed air quality modeling studies of CO "hot spots" across the region (e.g., downtown San Jose) may be conducted, and the need for additional control programs determined. If necessary, specific traffic and transportation controls will be tailored to meet the CO standards in each "hot spot" location.

In order to satisfy federal regulations, the California Air Resources Board would also have to designate the Bay Area as an Air Quality Maintenance Area for CO before federal funding could be used to develop a CO plan.

TASKS LEADING TO A NITROGEN DIOXIDE PLAN

Available evidence suggests that current violations of the State one-hour NO₂ standard may be primarily due to motor vehicle emissions. If so, the California Air Resources Board's existing motor vehicle control program may be sufficient to meet and maintain the State standard through the year 2000. To verify this hypothesis, meteorological data conducive to the buildup of high NO₂ concentrations would have to be developed for input to a detailed modeling analysis (e.g., using LIRAQ). A model verification analysis would have to be performed, and appropriate changes expected in NO_x emission levels would have to be tested. If the analysis suggests that additional controls would be required to meet the State NO₂ standard, then alternative control measures would be developed and assessed.

Additionally, the 1977 Clean Air Act calls for the setting of a new federal NO₂ standard for an averaging time no greater than three hours, if deemed appropriate by the EPA Administrator. If and when such a standard is promulgated by federal regulation, prospects for attainment and maintenance of that standard in the Bay Area will be assessed, and appropriate control measures developed as necessary.

TASKS LEADING TO A PLAN FOR TOTAL SUSPENDED PARTICULATE MATTER

In developing the initial AQMP, a preliminary analysis was made of the nature of the particulate problem in the region. In particular, an attempt was made to identify sources responsible for the problems. The analysis met with limited success because of specific deficiencies in the available data base. For example, a large fraction of the particulate matter currently measured consists of some form of organic matter. The fraction which is natural, e.g. insect

parts and pollen, versus that which is man-made such as soot and photochemical aerosols is unknown at this time. In addition, the portion of particulates due to background windblown dust versus what may be due to specific industrial or other human activity cannot be distinguished.

Rather than develop a plan based on indiscriminate controls over particulate emissions which may or may not contribute to the problem, a program for obtaining the necessary data has been developed. The program consists of the purchase, installation, and maintenance of advanced particulate monitoring equipment, as well as sophisticated chemical analysis of the particulate samples obtained. Funding required to support the expanded particulate sampling program is estimated to be \$500,000 over a three year period. Once the appropriate data are collected, the specific source categories responsible for elevated particulate levels in the atmosphere may be more clearly identified. Control strategies appropriate to the sources implicated would be developed and assessed.

TASKS LEADING TO A SULFUR DIOXIDE PLAN

As stated previously, the federal sulfur dioxide standard is not currently violated in the Bay Area, nor are future violations expected at this time. The basis for the original designation of the Bay Area as an SO₂ maintenance area is uncertain. It clearly needs to be reexamined. Unless the California Air Resources Board can provide a sound technical analysis to support the previous designation, it should be withdrawn.

The SO₂ standard recently adopted by the California Air Resources Board (.05 ppm SO₂ for 24 hours) is more complex than the federal standard in that it requires a simultaneous violation of either the State oxidant standard (.10 ppm for one hour) or the State particulate standard (100 µg/m³ for 24 hours) at the same monitoring location.

If applied in 1975, this standard would have been violated once in the Bay Area. It is not possible at this time to forecast whether future violations will occur in the region because there is no known analytical technique for making such a forecast. Ambient sulfur dioxide levels will increase substantially by 1985; however, if the Comprehensive Strategy is implemented, the State oxidant standard will be met by 1985. In addition, the State 24-hour particulate standard is most often violated in areas where there are no significant sources of sulfur dioxide emissions (i.e., Livermore, San Jose, and Fremont).

The future task for the continuing planning process is to develop methods for forecasting simultaneous violations of State standards as prescribed. Once these methods are developed and tested, alternative control measures can be developed if necessary.

OTHER STATE POLLUTANTS

As part of the initial AQMP planning effort, available data concerning a number of other pollutants was reviewed. The pollutants are lead, sulfates, hydrogen

sulfide and ethylene, and the California Air Resources Board has adopted ambient air quality standards for each of them. In order to develop a plan to meet those standards a substantial body of information must be compiled. This information includes:

- ambient monitoring data to decide whether standards are being exceeded
- emission inventory data to identify the sources and amounts of emissions
- alternative control techniques for reducing the emissions
- an appropriate emissions/air quality relationship to identify existing problems and to project future ones
- an analysis of whether proposed controls will be effective in eliminating the current and projected future problems

Lead

The information needed to prepare a plan for the attainment of the State lead standard can be compiled. It is quite probable that the existing controls on lead content of gasoline for new catalyst equipped vehicles will result in eliminating future lead problems. An analysis of this problem (or lack of one) should be conducted.

Sulfates

The State sulfate standard has been violated once over the past eight years in the Bay Area. Projected reductions in the availability of low sulfur fuels (e.g., natural gas) will result in increased sulfur dioxide emissions, and thus may result in increased sulfate levels. On the other hand, decreases in oxidant levels may also result in lowered sulfate levels. The task for the continuing planning process is to develop and implement a technique for projecting future sulfate levels to determine whether the State standard will be violated in the region. There is no reliable technique available at this time.

Hydrogen Sulfide

Existing BAAPCD regulations address the State standard for hydrogen sulfide and are currently being enforced. No additional plans or control programs appear necessary at this time.

Ethylene

Analysis of this pollutant is limited by the lack of ambient monitoring data and emission inventory data. Without ambient monitoring data, it is not possible to determine whether a problem exists. Future efforts for ethylene, therefore, require that a continuous monitoring program be implemented for that pollutant.

ORGANIZATION FOR THE CONTINUING PLANNING PROCESS

Section 3 of this chapter described how the AQMP was prepared. Of particular importance was the formation and work of the AQMP Joint Technical Staff, composed of staff members from ABAG, BAAPCD, MTC, CARB (in-kind services) and Caltrans (in-kind services). In addition, the Interagency Management Committee (ABAG, BAAPCD and MTC), AQMP Advisory Committee, Program Review Board, Air Quality Modeling Committee, and various consultants all played important roles in the preparation of this plan.

Future organization for the continuing planning process should build upon the success of the working relationships established. It should also provide for continued planning needs as previously identified and a program to monitor progress and implementation of the recommended actions. As an important part of the environmental management program in the Bay Area, the AQMP organizational structure also needs to continue addressing related water quality and solid waste management issues.

Organization for the continuing planning process must address three important functional areas:

- Staff work and analysis to develop additions, revisions, and updates to the plan, i.e. the AQMP Joint Technical Staff
- Policy guidance to the staff, e.g. the present Environmental Management Task Force
- Agreements for implementation, monitoring and enforcement of the plan

For each area cited, a number of options are possible. The EMTF Plan Implementation Committee has already discussed a wide variety of options for how the entire environmental management program should be updated, including the AQMP. Similarly, the BAAPCD Board of Directors has adopted a position on how the continuing planning process should be structured.

The Clean Air Act of 1977 also speaks to how such plans should be prepared. Under Section 174 of the Clean Air Act of 1977, entitled "Planning Procedures,"

"(a) Within six months after the enactment of the Clean Air Act Amendments of 1977, for each region in which the..., standard for carbon monoxide or photochemical oxidants will not be attained by July 1, 1979, the State and elected officials of affected local governments shall jointly determine which elements of a revised implementation plan will be planned for and implemented or enforced by the State and which such elements will be planned for and implemented or enforced by local governments or regional agencies, or any combination of local governments, regional agencies or the State....the implementation plan...shall be prepared by an organization of locally elected officials of local governments...and certified by the State for this purpose...Where feasible, such organization shall be the metropolitan planning organization...or the organization responsible for the air quality maintenance planning process...or the organization with both responsibilities."

As the draft AQMP proposals are reviewed, the options for continuing planning will also be discussed. In the current planning effort, ABAG has been the designated lead agency responsible for preparation of the AQMP. Until specific details are agreed to for how the future work is to be conducted, it is assumed the existing arrangements will continue.

Appendix-A

BIBLIOGRAPHY OF TECHNICAL MATERIALS

In the course of developing the Air Quality Maintenance Plan, numerous documents were written to describe the many issues and technical aspects of the plan. These have taken several forms:

- historical/background information
- technical memoranda
- issue papers
- briefs
- other technical support materials

Background reports describe the history air quality planning in the Bay Area and the role of the AQMP in this context. Technical Memoranda generally focus on a single topic and contain the assumptions and methodology for deriving quantitative information, e.g., emissions inventories, costs, control measure effectiveness. Issue papers contain discussions of issues for which there are several plausible alternative options. Where appropriate, these papers describe the reasoning behind the final, selected course of action. Briefs are status reports concerning the progress of the technical work written in popular language for the benefit of the general public. A variety of technical support materials relevant to AQMP development were obtained from other ABAG planning programs and/or other agency research efforts.

BACKGROUND

- "Summary of the Air Quality Maintenance Plan Work Program for the Bay Area Joint Technical Staff," November 1976.

This report describes the background, objectives and schedule for development of the Air Quality Maintenance Plan (AQMP). A joint air quality planning team with representatives from the appropriate regional agencies will perform the tasks of prediction and analysis, impact assessment, plan formulation and technical assistance in plan adoption process.

- "History of Air Quality Planning in the Bay Area," February, 1976.

This report describes the development of governmental agencies and programs to deal with the air quality problems of the Bay Area. The Bay Area Air Pollution Control District is the local agency with direct control over polluting activities (primarily

stationary sources). The California Air Resources Board was established in 1967 to deal with the state's air pollution problem. Transportation Control Plans for reduction of auto-related pollutants are developed by the Metropolitan Transportation Commission (for the Bay Area only). In May, 1975 the Association of Bay Area Governments was designated as the lead agency to develop an areawide waste treatment management plan under section 208 of the Federal Water Pollution Control Act Amendments of 1972. This plan encompasses air quality as well as water resources and solid waste planning.

AQMP/TECHNICAL MEMORANDA

- Air Quality Maintenance Plan Technical Memorandum 1, - "Base Year Selection and Technical Assumptions," September, 1976.

This report describes the base year selection process, and the technical assumptions for developing the stationary and mobile source inventories and the air quality model.

- Technical Memorandum 2, - "Projections/Forecasting: System Description and Technical Assumptions," December 1976.

This memorandum describes the air quality forecasting system which consists of three primary components: a) population, housing, employment and land use modeling system b) a travel demand modeling system and c) two air quality models (LIRAQ and Larsen).

- Technical Memorandum 3, - "Air Quality Past and Present," March, 1977.

This report presents a broad, regional perspective of the air quality problem. Annual summary maps based on 1975 data show the geographic variation of the five major pollutants and serve to identify the problem areas.

- Technical Memorandum 4, - "Status of Existing Controls Related to Air Pollution," March 1977.

This report summarizes the existing stationary source controls, motor vehicle emissions controls and transportation controls related to air pollution. Land use controls are also discussed although the relationship of policy to air quality is not clearly defined.

- Technical Memorandum 5, - "Candidate Control Measures," April 1977.

This report builds on Technical Memorandum 4 and presents a wide range of candidate controls for achieving air quality standards.

- Technical Memorandum 6, - "The AQMP: Legal Requirements," July, 1977.

Federal Clean Air legislation requires that air quality maintenance plans be developed for areas expected to exceed the National Ambient Air Quality Standards. This report briefly highlights the substantive and procedural regulatory requirements needed for an AQMP in the San Francisco Bay Area.

- Technical Memorandum 7, - "Development and Analysis of Alternative Air Quality Strategies," July 1977.

This report describes the way in which air quality strategies, which are comprised of combinations of candidate control measures, are modeled via the forecasting system described in Technical Memorandum 2.

- Technical Memorandum 8, - "Summary of the Technological Forecast for Motor Vehicle Emission Control," July 1977.

The results of a technology questionnaire on future developments in vehicle emission controls are presented in this report, along with the consequent planning assumptions for modeling future vehicle emissions.

- Technical Memorandum 9, - "Summary of Technology Forecast for Organic Solvents Emissions," July 1977.

The results of a technology forecast questionnaire on the decreasing use of organic solvents in surface coating operations are presented in this report. Predictions on organic solvent content in the future and the nature of the new technologies are given.

- Technical Memorandum 10, - "Summary of Technology Forecast Questionnaire: Combustion Sources," August 1977.

This report gives the results of a technology forecast on the status of combustion emissions control e.g., fuel desulfurization, flue gas desulfurization, ammonia injection, combustion modification. It also presents up-to-date estimates of control efficiencies and costs.

- Technical Memorandum 11, - "Present and Projected Air Pollution Emissions in the San Francisco Bay Region," August 1977.

This report identifies the significant sources of five major air pollutants in the Bay Region in order to provide direction for efforts to control emissions. Emission inventories have been compiled for 1975, 1985 and 2000. The most significant source categories are organic compounds evaporation (HC), light and heavy duty vehicles (HC, NO_x, CO) and stationary source fuel combustion (NO_x, SO_x). There exists some difficulty in identifying the sources of particulate emissions - a significant unknown amount, is from windblown dust and secondary organics (photochemical aerosol).

- Technical Memorandum 12 - "Baseline Motor Vehicle Emission Inventory: Methodology and Results," August, 1977.

This report describes the methodology for calculating present and projected pollutant emissions from motor vehicles in the Bay Region. The methodology is designed not only to compute total daily emissions but also to distribute the emissions geographically and by hour of the day.

- Technical Memorandum 13, - "Benefits of Photochemical Oxidant Control," December, 1977.

The benefits to be gained from additional control of photochemical oxidants are described. These benefits are gained in three general areas: improvements in public health; reduction in damage to vegetation; and reduction in damage to other materials.

- Technical Memorandum 14, - "Effectiveness and Costs of Alternative Air Pollution Control Programs," September, 1977

This report presents the estimated costs and effectiveness of the proposed air pollution control measures. Key assumptions in the method of implementation, the timing and the estimation methodologies are given.

- Technical Memorandum 15, - "Assessment of Alternative Air Pollution Control Programs," January, 1978.

This report summarizes the effects of the AQMP in sixteen impact areas such as physical resources, equity, mobility and energy.

- Technical Memorandum 16, - "Institutional, Legal and Financial Requirements for Implementing Proposed Air Pollution Control Programs," September, 1977.

This report discusses the roles of the various participating agencies (Bay Area Air Pollution Control District, Association of Bay Area Governments, Metropolitan Transportation Commission, Department of Transportation) in the AQMP Program. Institutional structures needed to implement the majority of the proposed AQMP actions are in existence. The need for new legislation is minimal. Greater emphasis will be necessary on structuring the institutional arrangements for implementing the transportation and land use programs.

- Technical Memorandum 17, - "Baseline LIRAQ Air Quality Projections," September 1977.

Includes a description of baseline LIRAQ simulations. Meteorological and emission inventory input files are described along with a summary of the model results for 1975 verification analysis and 1985 and 2000 projections assuming existing growth trends and controls.

- Technical Memorandum 18, - "LIRAQ Emissions Sensitivity Analysis," September 1977.

Documents the procedures, assumptions and results of varying emissions on air quality projections. The objective was to provide clues to the design of control strategies and to address the issue of the degree of control needed to attain the oxidant standard.

- Technical Memorandum 19, - "Applicability of Selected Statistical/Empirical Techniques to Air Quality Analysis in the San Francisco Bay Region," September 1977.

Documents the procedures and results of attempts to apply the well-known Larsen Model and the recently developed EPA ozone isopleth technique (also known as the Empirical Kinetic Modeling Approach, EKMA) to the Bay Area. The Larsen Model was found to be generally applicable except for a few cases, while the isopleth technique was found not to be applicable based on a limited sample of Bay Area monitoring data.

- Technical Memorandum 20, - "Procedure for Interpretation of LIRAQ Air Quality Projections," September 1977.

Problems and techniques employed to relate LIRAQ projections to the ambient air quality standard for oxidants are summarized. Adjustment factors are derived for application to the regionwide high hour oxidant level forecasted by the model to account for worst case conditions and imperfect validations. Limitations of LIRAQ grid coverage are also discussed.

- Technical Memorandum 21, - "Geographical Distribution of Emissions from Non-Major Point (Area) Sources," October 1977.

This memorandum describes the process and data used to characterize the spatial distribution of stationary area source emissions for LIRAQ modeling purposes. The cross-classification approach which was used is presented.

- Technical Memorandum 22, - "Regional Travel Projections for AQMP," November 1977.

This memorandum describes the methodology employed in preparing the regional motor vehicle travel projections used in developing the AQMP. A summary of vehicle miles travelled and vehicle trips for each case analyzed is also included with a discussion of the results.

- Technical Memorandum 23, - "Evaluation of Transportation Control Measures," November 1977.

This memorandum presents the methodology for evaluating and screening transportation control measures, as well as the results of the screening. Each alternative control measure is described and its potential effectiveness in reducing emissions is presented.

- Technical Memorandum 24, - "Analysis of Suspended Particulate Matter in the San Francisco Bay Region," November 1977.

This memorandum describes the results of applying a chemical mass balance technique for identifying source-receptor relationships for suspended particulate matter in the region.

AQMP/ISSUE PAPERS

- Issue Paper 1, - "Air Quality Modeling for the San Francisco Bay Region," September 1976.

This paper describes the selection of the appropriate air quality models for developing the AQMP. It describes the physical factors for model selection, the alternative models available, the criteria for model selection, and the recommended models. A description of the Lawrence Livermore Lab Regional Air Quality Model (LIRAQ) is included.

- Issue Paper 2, - "The Air Quality Modeling Process: Accuracy and Related Issues," May 1977.

This paper describes the process by which air quality models will be applied and interpreted in the AQMP. The main focus is on photochemical oxidant modeling since it presents the most severe problem in terms of modeling difficulties and anticipated control requirements.

- Issue Paper 3, - "Regional/Local Issues in Land Use Controls for Improving Air Quality."

This paper reviews the process by which land use controls have been examined in the AQMP. It presents the complete testing of land use control measures, the pertinent local, regional and state agencies having responsibility for each action and the effects of these measures on such criteria as projected auto travel, the acreage of developed land and transit usage.

AQMP BRIEFS

- Environmental Management Program, "Air Quality Maintenance Plan Brief No. 1 - The Goal, Future Decisions, Issues and Organization," March 1977.

Brief No. 1 describes the goal, key issues and program organization of AQMP. The goal is stated as being the attainment and maintenance of State and Federal air quality standards as expeditiously as practicable. The Statement of Issues seeks to resolve the differences between the State and Federal standards, to identify appropriate level of governmental responsibility for air pollution controls and to establish a schedule for delivery of the final product.

- "Air Quality Maintenance Plan Brief No. 2 - Alternative Air Quality Strategies," June 1977.

This Brief describes the existing air pollution control strategies, the candidate control measures, the format of the final product, and the progress and schedule.

- "Air Quality Maintenance Plan Brief No. 3 - Air Quality Problems," August 1977.

Brief No. 3 describes the past, present and future air quality problems in the Bay Area. The future air quality is projected assuming no additional control programs beyond those currently adopted. A preliminary estimate of the air pollutant emissions reduction required to achieve the program goal is given, along with an updated view of the final product.

- "Air Quality Maintenance Plan Brief No. 4 - Progress Report on Development of the Air Quality Maintenance Plan," October 12, 1977.

Brief No. 4 describes three key aspects of the AQMP: (1) Results of photochemical oxidant modeling activities conducted to date; (2) Requirements for meeting the 0.08 ppm Federal oxidant standard; and (3) Considerations for dealing with technical uncertainty.

OTHER TECHNICAL SUPPORT MATERIALS

- Association of Bay Area Governments, "Economic and Air Quality Impacts of New Source Review Regulations in the San Francisco Bay Area," prepared for the Bay Area Air Pollution Control District Board of Directors, November, 1977.

The purpose of this study is to assess the major impacts of alternative new source review regulations. The Air Pollution Control District staff prepared 12 possible changes in the new source review rule as currently embodied in BAAPCD Regulation 2, Section 1309.

Since the start of the study the Environmental Protection Agency has issued guidelines for new source review regulations, including emission offset policies. Interpretation of the guidelines would seem to preclude some of the alternatives. Yet the systematic examination of all the alternatives provided an important comparison of the effects of each option.

- Barton-Aschman Associates, Inc., "Sensitivity Analysis of Selected Control Measures: Potential Reductions in Regional Vehicle Miles of Travel," Memorandum #1 to the Metropolitan Transportation Commission, July 22, 1977.

The results of a mode-split sensitivity analysis conducted for 13 different transportation control strategies in the San Francisco Bay Area are described. Forecasts of 1985 mode-split changes for auto, transit, and shared-ride trips from the proposed strategies are estimated. Only home-based work trips were examined to obtain a sample of origin-destination districts across the region. Five different origin districts were identified, and trip interchanges between these districts and the San Francisco central business district (CBD), as well as an Oakland industrial area, were investigated. These two destinations were meant to represent CBD and non-CBD trips, respectively.

- Barton-Aschman Associates, Inc., "Sensitivity Analysis of Selected Transportation Control Measures: Potential Reductions in Regional Vehicle Miles of Travel," Memorandum #2 to the Metropolitan Transportation Commission, August 12, 1977.

A continuation of the work described in the July 22, 1977 memorandum cited above is reported. Potential changes in mode-split for auto, transit, and shared-ride trips identified in the July 22 memorandum are converted to an estimated range of impacts at the regional level. Elasticities of nine of the 13 individual transportation control strategies were plotted and normalized effectiveness indices are computed, for each of the three modes for CBD and non-CBD travel. Relative changes in each of nine transportation control strategies are reported. In addition, four combination transportation control strategies were also tested for their effect on mode choice for CBD and non-CBD trips.

- Bay Area Air Pollution Control District, "Emission Inventory Impact and Cost of Implementation of Proposed Stationary Source Controls," prepared for AQMP Joint Technical Staff by BAAPCD, August 14, 1976.

The report describes the potential emissions reductions from certain industrial categories that can be expected from a number of stationary source control options. These measures, four of which are recommended in the AQMP for stationary source emission controls, are described separately in the report. Estimated costs for the measures are also presented.

- Bay Area Air Pollution Control District, "Method of Projection," (Draft), May 31, 1977.

This report contains the Air Pollution Control District staff's methodology for estimating stationary source and aircraft emissions for the years 1975, 1985, and 2000.

- Bay Area Air Pollution Control District, "Emission Inventory Summary Report," August 18, 1977.

This document contains the Air Pollution Control District staff's estimates of stationary source and aircraft emissions for the years 1975, 1985, and 2000.

- W. Duewer, "Suggested Revision of the LIRAQ Hydrocarbon Emissions Inventory," Lawrence Livermore Laboratory UASG 77-6, prepared for the Air Quality Maintenance Plan - Joint Technical Staff, April 12, 1977.

This report describes two procedures for assigning hydrocarbon emissions to the three hydrocarbon reactivity utilized by LIRAQ. The first procedure is designed to convert detailed emissions by source type as provided by Trijonis, et al, into LIRAQ reactivity classes. The second is designated for use with the CARB adopted three hydrocarbon reactivity category system.

- J. Da Cunha, S. Cambell, V. Petrites, "Generation of 1975/85 Modal Split Ratios for Input to PLUM," memorandum to Modeling and Analysis Team, ABAG/MTC Joint Planning Program, Working Paper #27-Series 3, April, 1976.

The transportation related part of the Projected Land Use Model (PLUM) allocates employed residents from zone of work to zone of residence using both highway and transit travel time matrices. The proportion of employed residents allocated to zones of residence by each mode was done using the modal split ratio at the zone of work. This report describes the procedure used to take 1965 and calculated 1990 modal split ratios and interpolate them for 1975 and 1985.

- S. Chaitkin and H. Kollo, "Series 3 Highway Network (1965, 1975, and 1985) Inputs to PLUM," memorandum to Modeling and Analysis Team, ABAG/MTC Joint Planning Program, Working Paper #29-Series 3, August, 1976.

This working paper describes the assumptions used by the Metropolitan Transportation Commission (MTC) to develop the 1965, 1975, and 1984 440 zone matrices of travel times for the highway mode. These matrices were used by the ABAG/MTC Joint Planning Program for PLUM validation and projections. Discussed are the following characteristics of Series III highway networks for each of the three specified years: facility assumptions, speed/service level representation, supplementary travel time estimations, final preparation for input to PLUM and comparison of the resulting travel time estimations.

- S. Chaitkin and H. Kollo, "Series 3 Transit Network (1965, 1975, and 1985) Inputs to PLUM," memorandum to Modeling and Analysis Team, ABAG/MTC Joint Planning Program, Working Paper #30-Series 3, January, 1977.

This working paper describes the assumptions used by MTC to develop the 1965, 1975, and 1985 440 zone matrices of travel times for the transit mode. These matrices were also used by the ABAG/MTC Joint Planning Program for PLUM validation and projections.

Discussed are the following characteristics of Series III transit networks for each of the three specified years: facility assumptions, speed/service level representation, supplementary travel time estimations, final preparations for input to PLUM, and comparison of the resulting travel time estimations.

- J. Holtzclaw, "Projecting Migration in the San Francisco Bay Area," memorandum to Modeling and Analysis Team, ABAG/MTC Joint Planning Program, Working Paper #33-Series 3, August, 1976.

This working paper reviews methodologies for analyzing and projecting net migration into regions like the Bay Area. Continuing beyond ABAG's use of California Department of Finance projections in Series I and Series II, the findings of this report were used to guide the population and labor force migration projections in Series III.

- S. Hoffman, "General Description of Series 3 Projection System," memorandum to Modeling and Analysis Team, ABAG/MTC Joint Planning Program, Working Paper #36-Series 3, October 28, 1977.

This working paper describes the Series III projection system including: 1) the models that comprise the system and their inter-relationships; 2) their data inputs and projection outputs; 3) the major assumptions that control the projections; and 4) the relationship of the projections to the Environmental Management Program (EMP).

- Association of Bay Area Governments, "Summary Report - Provisional Series 3 Projections of Population, Housing, Employment, and Land Uses in the San Francisco Bay Region," March, 1977. (Final documentation available January, 1978.)

This report summarizes projections of population, housing, employment and land uses for the San Francisco Bay Region. Provisional Series III projections are presented for the nine county region through the year 2000. For counties and smaller areas of the region the projections are presented for the period through 1990.

- M.C. MacCracken and G.D. Sauter, Eds., "Development of an Air Pollution Model for the San Francisco Bay Area" - Final Report to The National Science Foundation, Vol. 1, Lawrence Livermore Laboratory, UCRL-51920 Vol. 1, Rev. 1, October, 1975.
- M.C. MacCracken and G.D. Sauter, Eds., "Development of an Air Pollution Model for the San Francisco Bay Area" - Vol. 2 Appendices, Lawrence Livermore Laboratory, UCRL-51920 Vol.2, October, 1975.
- M.C. MacCracken, "User's Guide to the LIRAQ Model: An Air Pollution Model for the San Francisco Bay Area," Lawrence Livermore Laboratory, UCRL-51983, December, 1975.

This User's Guide has been written to assist the potential user of the LIRAQ model to conduct numerical simulations at the Lawrence Berkeley Laboratory (LBL) Computer Center. Although the models have focused on simulation of Bay Area air quality, they have been designed so that transfer to other regions is possible.

- M.C. MacCracken, D.J. Wuebbles, J.J. Walton, W.H. Duewer, and K.E. Grant, "The Livermore Regional Air Quality Model: I. Concept and Development," Lawrence Livermore Laboratory, preprint UCRL-77475 Pt. 1, Rev. 2, August, 1977.

This and the following series of reports present the physical and mathematical basis for the Livermore Regional Air Quality (LIRAQ) model that has been developed for use in the San Francisco Bay Region. The model considers the complex topography, changing meteorology, and detailed source emission patterns in generating surface and vertical average pollutant concentrations with grid resolutions of 1, 2, or 5 km.

- W.H. Duewer, M.D. MacCracken, and J.J. Walton, "The Livermore Regional Air Quality Model: II. Verification and Sample Application in the San Francisco Bay Area," Lawrence Livermore Laboratory, preprint UCRL-77475 Pt. 2, Rev. 2, August 1977.

In this paper, topographic, meteorological, source emission and atmospheric pollution concentration data have been assembled for use in verifying the LIRAQ-1 and LIRAQ 2 regional air quality models in the San Francisco Bay Area. These observed data indicate that the temporal and spatial phasing for concentrations of carbon monoxide, ozone, and nitrogen oxides can be adequately represented by the models.

Limited sensitivity studies were also conducted with the LIRAQ models. The results indicate that initial and horizontal boundary conditions as well as grid size and subgrid-scale effects, while very significant in predicting air quality on the local scale, are less important in dealing with regional concentrations of pollutants than are emissions, meteorological conditions and vertical boundary conditions.

Appendix-B

AIR POLLUTION CONTROL COSTS

Air pollution control costs have been estimated for three different types of sources: stationary (e.g., industry), mobile (e.g., automobiles, trucks) and transportation (i.e., from vehicle miles of travel, traffic). Cost estimates are comprised of three components:

- capital construction costs
- operational and maintenance costs and revenue
- administrative/regulatory costs.

These costs will be expended over a period of time from 1977 to 2000 in accordance with a schedule of implementation (which varies with each recommendation).

The Bay Area Air Pollution Control District has estimated the costs of the recommended stationary source control measures in each cost category. The California Air Resources Board has similarly estimated costs for motor vehicle emission controls and the Metropolitan Transportation Commission has estimated costs for transportation controls. These estimates are shown in Table B-1. A breakdown of the costs for best available control technology (Action 3 in Table B-1) is presented in Table B-2.

In order to be able to compare the costs of alternative AQMP control recommendations, a cost assessment convention has been applied whereby the cost components are discounted and the resultant present values are converted into equivalent annual costs.* This convention has been established by the Environmental Protection Agency in the "Guidelines for State and Areawide Water Quality Management Program Development" and it has been applied by ABAG to the other management plans as well.

Expenditures for air pollution control do not necessarily occur in the year that the plan is implemented. Therefore, costs that are expended at a future time are discounted at a prescribed rate of 6 3/8% to obtain a present value. Discounting is a way to account for the opportunity cost of funds invested in a project in the sense that the funds could be invested in alternative ways. The present value represents the amount of funds that is required at the present time which, if invested at 6 3/8%, would be sufficient to finance the recommended control at some specified future time of implementation.

*The resulting equivalent annual costs are reported in the Section 7 plan summary table.

After discounting, the resultant present value costs are converted to a uniform schedule of payment over the period 1977-2000. This is the equivalent annual cost and is analogous to a monthly mortgage payment. All recommendation costs in the Environmental Management Plan are presented in this manner.

Discounting - The future costs of a control are discounted to the base year, 1977, according to the formula:

$$PV = \frac{TC}{(1 + R)^n}$$

where PV = present (i.e., discounted) value
 TC = the undiscounted cost incurred in a given year
 R = the discount rate = 6 3/8%
 n = the number of years beyond 1977 when the cost is incurred (n=0 for 1977, 1 for 1978, 2 for 1979, etc.)

This formula is applied to each year in which a cost is incurred. The resultant present values are summed to obtain a total present value.

Salvage Value - At the end of the planning period (1999) structures and equipment are assumed to have a salvage value based on the remaining functional life of the structure. The remaining life is computed according to a straight line depreciation over an assumed service life. The salvage value is subtracted from last year's costs.

Equivalent Annual Cost - The total present value costs are converted (i.e., amortized) to an equivalent annual cost according to the following formula:

$$EAC = \frac{TPV \times R}{1 - \frac{1}{(1 + R)^n}}$$

where EAC = the equivalent annual cost
 TPV = the total present value
 R = the discount rate = 6 3/8%
 n = the number of years in the planning period = 23

Base Year - All cost estimates are in 1977 dollars. The Engineering News Record for Construction Costs (ENRCC) index was applied in cases where current estimates were not available (see Table B-3).

Schedule for Implementation - Cost estimates (i.e., capital, operational/maintenance, administration/regulatory) were provided by the respective agencies with jurisdiction over the source type. An approximate time schedule for cost expenditures was subsequently developed for each control recommendation. This schedule (as shown in Table B-1) formed the basis for the discounting and annualizing computations.

Appendix-B

AIR POLLUTION CONTROL COSTS

Air pollution control costs have been estimated for three different types of sources: stationary (e.g., industry), mobile (e.g., automobiles, trucks) and transportation (i.e., from vehicle miles of travel, traffic). Cost estimates are comprised of three components:

- capital construction costs
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*The resulting equivalent annual costs are reported in the Section 7 plan summary table.

After discounting, the resultant present value costs are converted to a uniform schedule of payment over the period 1977-2000. This is the equivalent annual cost and is analogous to a monthly mortgage payment. All recommendation costs in the Environmental Management Plan are presented in this manner.

Discounting - The future costs of a control are discounted to the base year, 1977, according to the formula:

$$PV = \frac{TC}{(1 + R)^n}$$

where PV = present (i.e., discounted) value
 TC = the undiscounted cost incurred in a given year
 R = the discount rate = 6 3/8%
 n = the number of years beyond 1977 when the cost is incurred (n=0 for 1977, 1 for 1978, 2 for 1979, etc.)

This formula is applied to each year in which a cost is incurred. The resultant present values are summed to obtain a total present value.

Salvage Value - At the end of the planning period (1999) structures and equipment are assumed to have a salvage value based on the remaining functional life of the structure. The remaining life is computed according to a straight line depreciation over an assumed service life. The salvage value is subtracted from last year's costs.

Equivalent Annual Cost - The total present value costs are converted (i.e., amortized) to an equivalent annual cost according to the following formula:

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where EAC = the equivalent annual cost
 TPV = the total present value
 R = the discount rate = 6 3/8%
 n = the number of years in the planning period = 23

Base Year - All cost estimates are in 1977 dollars. The Engineering News Record for Construction Costs (ENRCC) index was applied in cases where current estimates were not available (see Table B-3).

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ACTION	(1)			(2)			(3)			(4)			(5)			(6)			(7)		
	surface coating			closed system organic storage			best available control technology			New Source Review			new vehicle emission standards			inspection & maintenance			heavy duty vehicle retrofit		
	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R
1977																					
8																					
9																					
1980																					
1																					
2																					
3	\$71M			\$185M			\$299M														
4																					
5		3.7M			9.2M			17M													
6		"			"			"													
7		"			"			"													
8		"			"			"													
9		"			"			"													
1990		"			"			"													
1		"			"			"													
2		"			"			"													
3		"			"			"													
4		"			"			"													
5		"			"			"													
6		"			"			"													
7	15M	"		123M	"		163M	"													
8		"			"			"													
1999		4.3M			15.M			26M													
Economic Life (Years)	16			16			25														

- Notes:
- a) M = million
 - b) 1977 dollar base
 - c) C = capital construction costs
 - d) O/M = annual operating/maintenance costs and revenue
 - e) A/R = administrative regulatory costs
 - f) The economic life is stated for measures where capital construction costs are incurred. It is used to compute the salvage value of capital equipment at the end of the analysis period.

TABLE B-1 - BASE AIR POLLUTION CONTROL COSTS

B-4

ACTION	(8)			(9)			(10)			(11)			(12)			(13)			(14)			(15)		
	increase			parking tax			preferential parking			additional transit			bus/carpool lanes & ramp metering on fwys.			S.F. auto free zones			carpool matching program			bicycle system		
	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R	C	O/M	A/R
1977																								
8																								
9		\$12.6M																						
1980		12.9M			\$7M	\$17,000		\$1M	\$30,000	\$57M	\$20M		\$139M			\$123,000	\$134,000						\$300,000	
1		13.1M			"	"		"			"													\$300,000
2		13.5M			"	"		"			"													200,000
3		13.8M			"	"		"			"													"
4		13.9M			"	"		"			"													"
5		14.0M			"	"		"			"													"
6		14.1M			"	"		"			"													"
7		14.2M			"	"		"			"													"
8		14.3M			"	"		"			"													"
9		14.4M			"	"		"			"													"
1990		14.5M			"	"		"			"													"
1		"			"	"		"			"													"
2		"			"	"		"			"													"
3		"			"	"		"			"													"
4		"			"	"		"			"													"
5		"			"	"		"			"													"
6		"			"	"		"			"													"
7		"			"	"		"			"													"
8		"			"	"		"			"													"
1999		"			"	"		"			"													"
Economic Life										15			25			15			Life					Permanent

TABLE B-1 (Continued)

Table B-2. Breakdown of Costs and Hydrocarbon Emission Reductions by Process Category

BAAPCD Process Category	Emission Reduction (Tons/Day)		CONTROL COSTS ^a				BACT ^b
	1985	2000	1985		2000		
			CAP (\$ million)	O/M	CAP (\$ million)	O/M	
2 - Petroleum Refining - Other Processes ^c	16.9	22.3	\$10.	\$1.1	\$17.5	\$1.1	BM & PC
3 - Petroleum Refining - Upsets, Breakdowns	2.6	3.5	1.	.1	1.2	.12	BM & PC
9 - Other Chemical	2.6	3.1	1.5	.075	1.8	.09	incinerator, low-no solvent coatings, fume scrubbers
19 - Food/Agric. Processing	3.7	4.3	1.5	.075	1.8	.09	5, 6, 14, 16
23 - Storage & Blending	17.5	27.9					
24 - Marine Loading	5.4	8.2					
25 - Bulk Plants	.8	13.6	150.	7.5	250.	12.5	3
29 - Storage Tanks - Solvent	5.7	9.7					
30 - Storage Tanks - Other Organic Compounds	3.4	5.8					
31 - Industrial Coating Solvent	38.	52.					
32 - Industrial Coating - Water	.3	.5	58.	3.	70.	3.5	incinerator, low-no solvent coatings, fume scrubbers
33 - Com'l. & Dom. Coating - Solvent	19.	23.					
34 - Com'l. & Dom. Coating - Water	2.7	4.5					

Notes: a/2000 costs include those of 1985; 1975 dollar base

b/BACT = best available control technology
BM & PC = better maintenance and process changes

c/Costs for this source category are considered underestimates, due to difficulties in isolating the cost of BACT from other process and equipment changes which refineries may opt to implement simultaneously.

Table B-2 (Continued)

BAAPCD Process Category	Emission Reduction (Tons/Day)		CONTROL COSTS ^a				BACT ^b
	1985	2000	1985		2000		
			CAP (\$ million)	O/M	CAP (\$ million)	O/M	
35 - Degreasers	35.	42.	\$6.	\$.6	\$8	\$.8	absorption
36 - Dry Cleaners - PERC	13.	30.	2	.2	5	.5	closed system with solvent recovery
38 - Rubber Frabrica- tion	4.7	5.	1.5	.2	1.8	.2	solvent re- covery
39 - Plastic Frabrica- tion	23.	28.	6	.6	7	.7	solvent re- covery
40 - Printing	9.	21.	2	.2	5	.5	absorption
41 - Other Or- ganics Evaporation	20.	39.	5	.5	9	.9	absorption
Total	226.8	339.1	\$243	\$14.	\$376.	\$21.	
1977 dollar base			\$299	17	462	26	

Notes: a/2000 costs include those of 1985; 1975 dollar base

b/BACT = best available control technology
BM & PC = better maintenance and process changes

TABLE B-3

ENGINEERING NEWS RECORD
CONSTRUCTION COST INDEX
(ENRCC)¹

Date	San Francisco ²	U.S.-20 Cities Average ²
January 1977	3100 ³	2494
May 1976	2824	2328
June 1975	2518	2205
July 1974	2287	2041
June 1973	2224	1896
July 1972	2074	1726
June 1971	1709	1575
June 1970	1515	1369
July 1969	1525	1283

¹Based on 1913 U.S. average = 100

²Numbers are rounded to tenths

³An ENRCC of 3100 is being used for the Environmental Management Plans.

Appendix-C

RESULTS OF THE

LIRAQ EMISSIONS SENSITIVITY ANALYSIS

This appendix is a more detailed description of the results of the LIRAQ emissions sensitivity analysis which was described briefly in Section 6.

Table C-1 gives the result of holding constant the prototype meteorology, while varying the percent reductions in future year precursor emissions. Each column of the table corresponds to a different combination of percent reductions in hydrocarbon and nitric oxide emissions. The first five columns show zero for percent reductions in NO emissions, so results in these columns pertain to reductions in only hydrocarbon emissions, with the first column being simply the 1985 baseline results. The last two columns give results for simultaneous reduction in hydrocarbon and nitric oxide emissions. All results in Table 1 are for the same inventory year, 1985, and same prototype meteorology, July 26, 1973.

Table C-1, LIRAQ Emission Sensitivity Analysis Results

% Reduction HC	0	20	40	60	80	40	80
% Reduction NO	0	0	0	0	0	20	40
Expected worst-case regionwide high hour ozone (ppm)	.19	.14	.08*	.07	.06	.11	.06

* This value was rounded off from an original value of .0846 ppm.

Assumptions: 1) 1985 Baseline Emission Inventory
 2) July 26, 1973 Prototype Meteorology

Figure C-1 is a plot of regionwide high hours versus percent reduction of the hydrocarbon only emissions. These curves allow a more precise interpolation of percent reduction in hydrocarbon only emissions to meet the standard. Figure C-1 shows the required number to be 43% on a worst case basis.

The sixth column of Table C-1 shows that the regionwide high hour for a 40% hydrocarbon emissions reduction simultaneous with a 20% nitric oxide emissions reduction is 0.11 ppm of ozone. This number is 0.03 ppm greater than the regionwide high hour for 40% only emission reduction. Figures C-2, C-3, and C-4 have been prepared to highlight this effect. Figure C-2 shows the east-west traverse AA' along which map ozone* has been plotted in Figure C-3. Figure C-2 is the baseline map

* "map ozone" is to be distinguished from "hourly averaged" ozone. The latter has been averaged over one hour in time. Map ozone is read directly from maps like Figure 2 and is not averaged over one hour.

for 1985 emissions and July 26, 1973 meteorology at 1500 PST, the hour when the highest map ozone occurred 9.5 kilometers SSE of Livermore. The section line AA' is through this point of maximum map ozone, as is the north-south traverse BB'. The curves labeled "baseline" in Figures C-3 and C-4 represent ozone cross-sections through this ozone "high", along traverses AA' and BB' respectively.

Similarly, for the 1985 inventory and July 26, 1973 meteorology, the other curves in Figures C-3 and C-4 represent ozone cross-sections along identical traverses AA' and BB' for LIRAQ map outputs obtained when the emissions input is reduced by 20% HC, 40% HC, 60% HC, 80% HC, and 40% HC/20% NO. Curve labels correspond to the various percent reductions.

The six curves in Figures C-3 and C-4 clearly show the geographic variation of the various percent reductions in precursor emissions. In particular the 40% HC/20% NO curve is shown to exceed the 40% HC only curve almost everywhere along the two cross-sections.

Subsequent to this initial series of sensitivity tests, an additional test consisting of no hydrocarbon emissions reduction and a 40% nitric oxide emission reduction was made. The result was a substantial increase in oxidant levels above the baseline level in upwind urban source areas, and a slight decrease from baseline levels in downwind non-urban areas. This result is highlighted in Figure C-5, which shows the results of the 40% NO reduction test relative to the other sensitivity tests conducted.

Example maps from the sensitivity analysis tests are shown in Figures C-6 through C-10.

Implications for Control Strategies

The main implications are:

- reduction of hydrocarbon emissions alone is more effective than joint reduction of hydrocarbon and nitric oxide emissions, for the percentages examined,
- "Nitric oxide quenching" is a likely explanation for this result,
- a 43% reduction of hydrocarbon emissions will attain the standard in 1985,
- by extrapolation of this 1985 result**, a 56% reduction of hydrocarbon emissions will attain the standard in 2000.

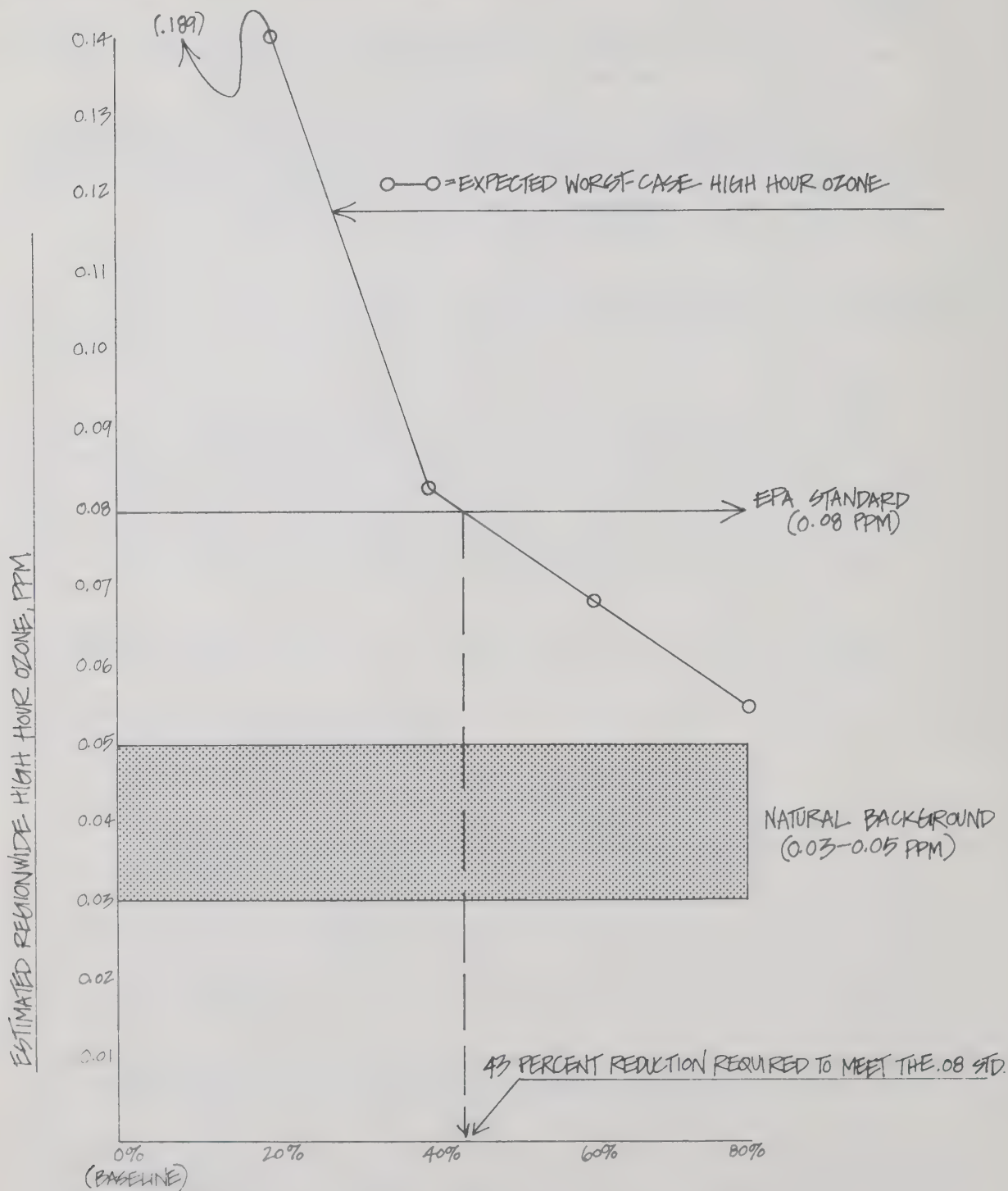
** The calculation is to apply the 43% reduction to total 1985 organic emissions. This leaves 1985 total organic emissions at approximately 450 tons/day. If a 56% reduction is applied to total 2000 organic emissions, the same remainder is obtained, 450 tons/day.

The conclusion should not be reached that maximizing NO_x emissions controls, to take advantage of NO quenching, is a viable strategy, for two reasons:

- a California standard presently exists for one hourly averaged nitrogen dioxide, which is exceeded in the region,
- the EPA is presently examining the criteria for a one to three hourly averaged nitrogen dioxide standard, in addition to the present annual average standard for nitrogen dioxide. EPA could issue such a standard in 1978.

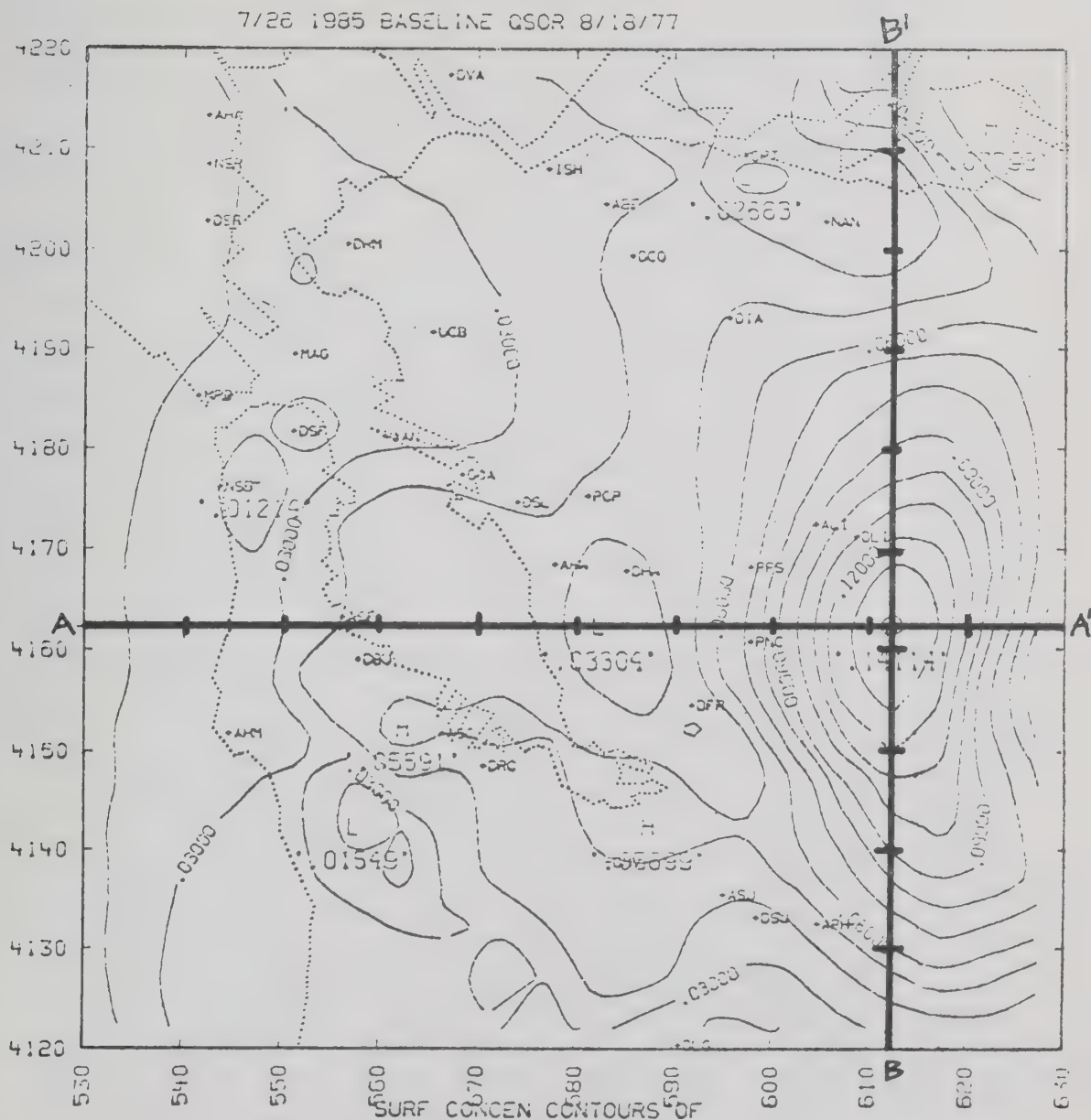
FIGURE C-1.

PLOT OF ESTIMATED REGIONWIDE HIGH HOUR OZONE AS A FUNCTION OF % REDUCTIONS OF 1985 HC EMISSIONS



PERCENT REDUCTION OF 1985 BASELINE HYDROCARBON EMISSIONS

FIGURE C-2.



OZONE

```

CONTOUR: MINIMUM 2.0000E-02 LABEL SCALING 1.0000E+00
          MAXIMUM 1.4000E-01
          INTERVAL 1.0000E-02

```

SCALE = 5.0 KM

TIME
15: 0.
JULY 26 1973

FIGURE C-3 EMISSION SENSITIVITY RESULTS COMPARED BY VARIOUS PERCENT REDUCTIONS ALONG SECTION AA' OF FIGURE C-2

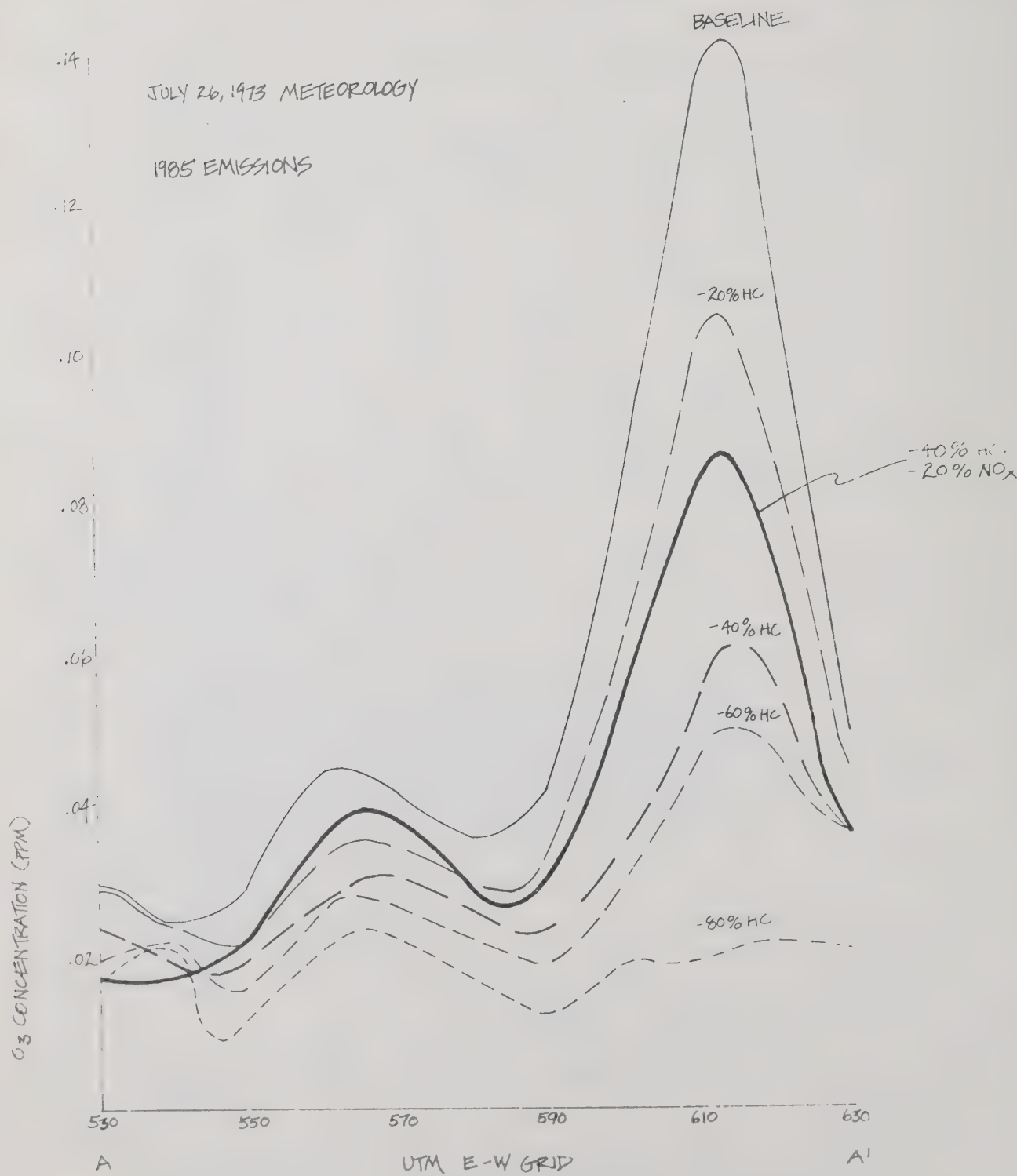


FIGURE C-4 EMISSION SENSITIVITY RESULTS COMPARED BY VARIOUS PERCENT REDUCTIONS ALONG SECTION BB' OF FIGURE C-2

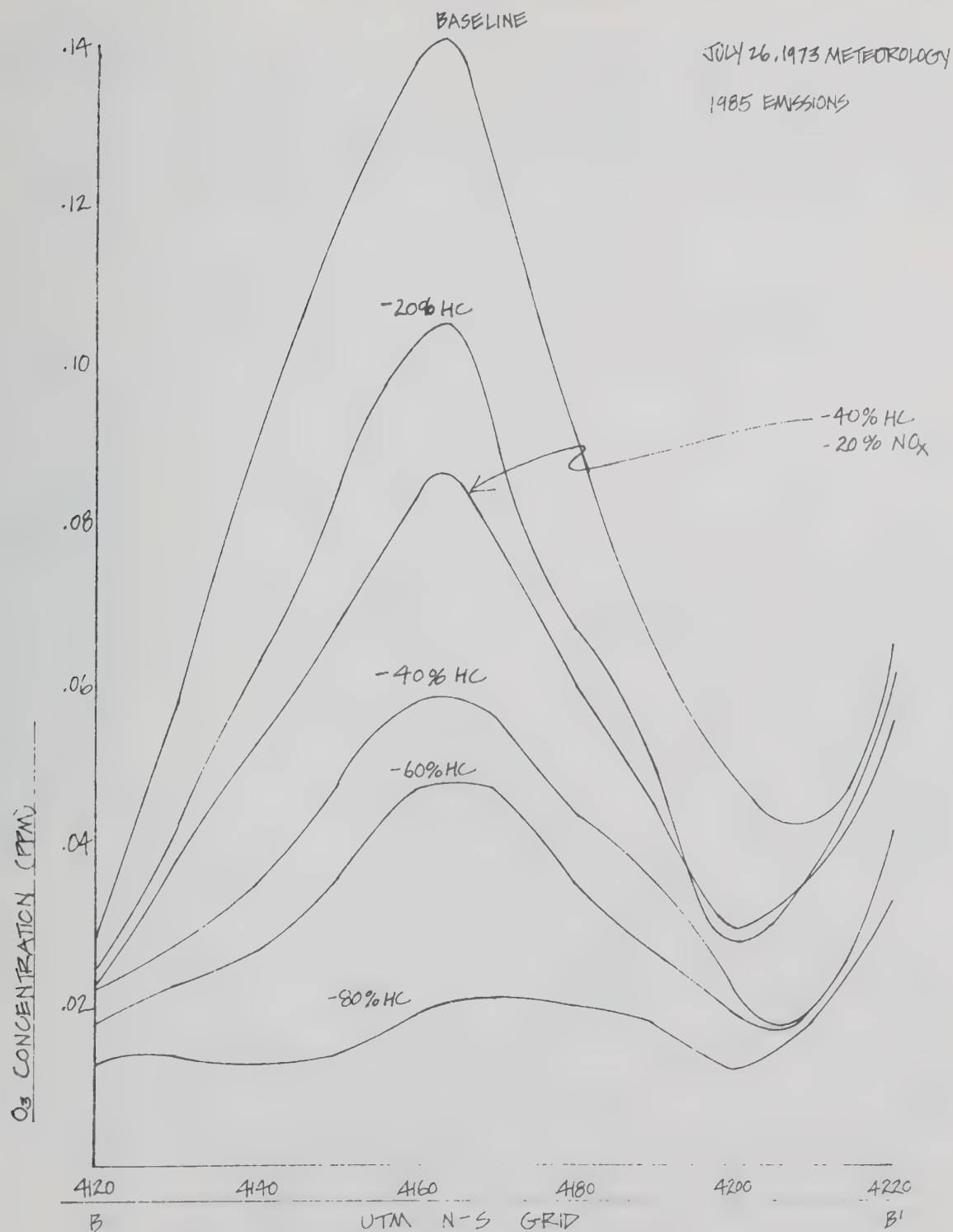


FIGURE C-5- EMISSIONS SENSITIVITY RESULTS ALONG SECTION AA' OF FIGURE C-2 INCLUDING THE EFFECT OF A 40% NO EMISSION REDUCTION WITH NO REDUCTIONS IN HYDROCARBON EMISSIONS.

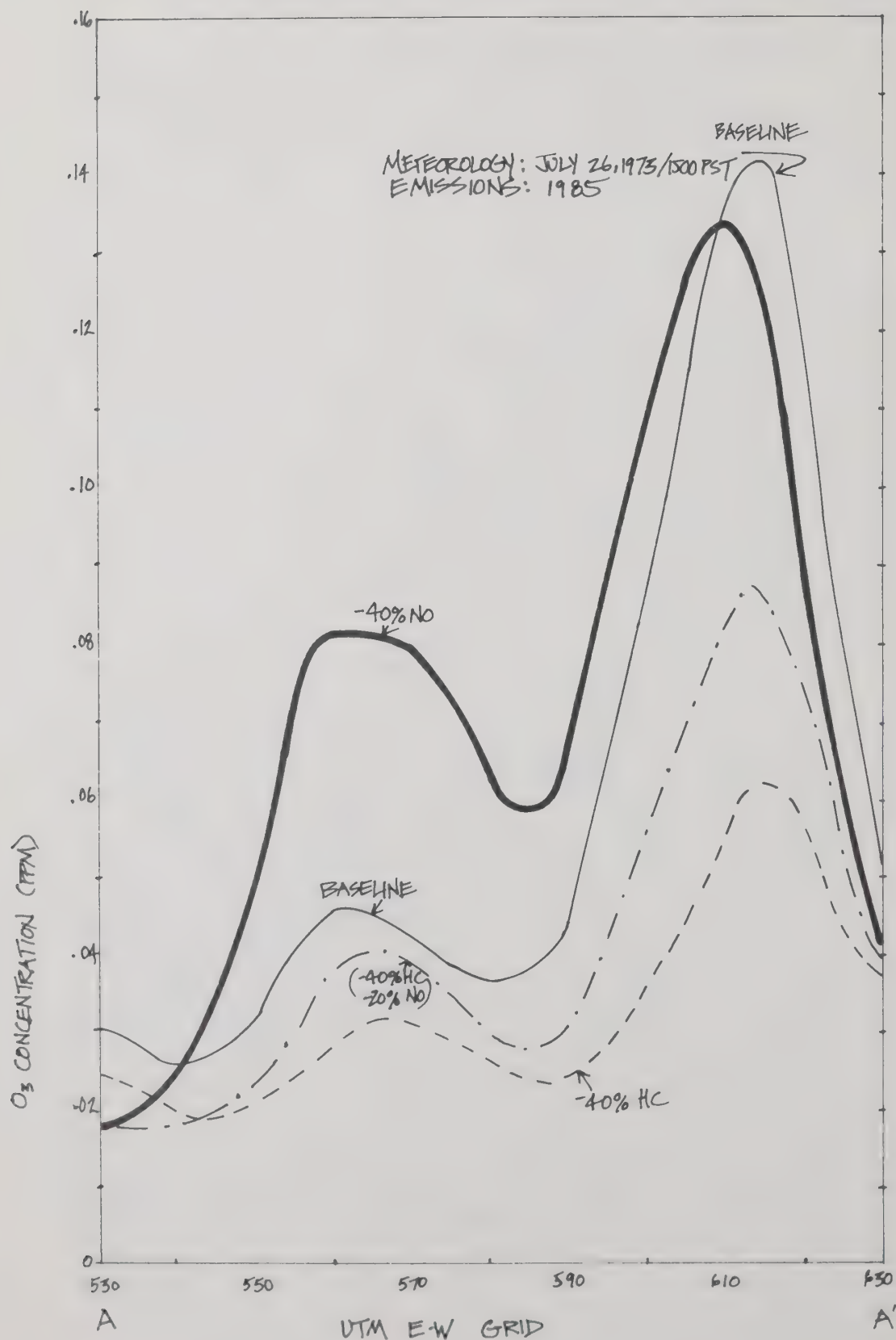
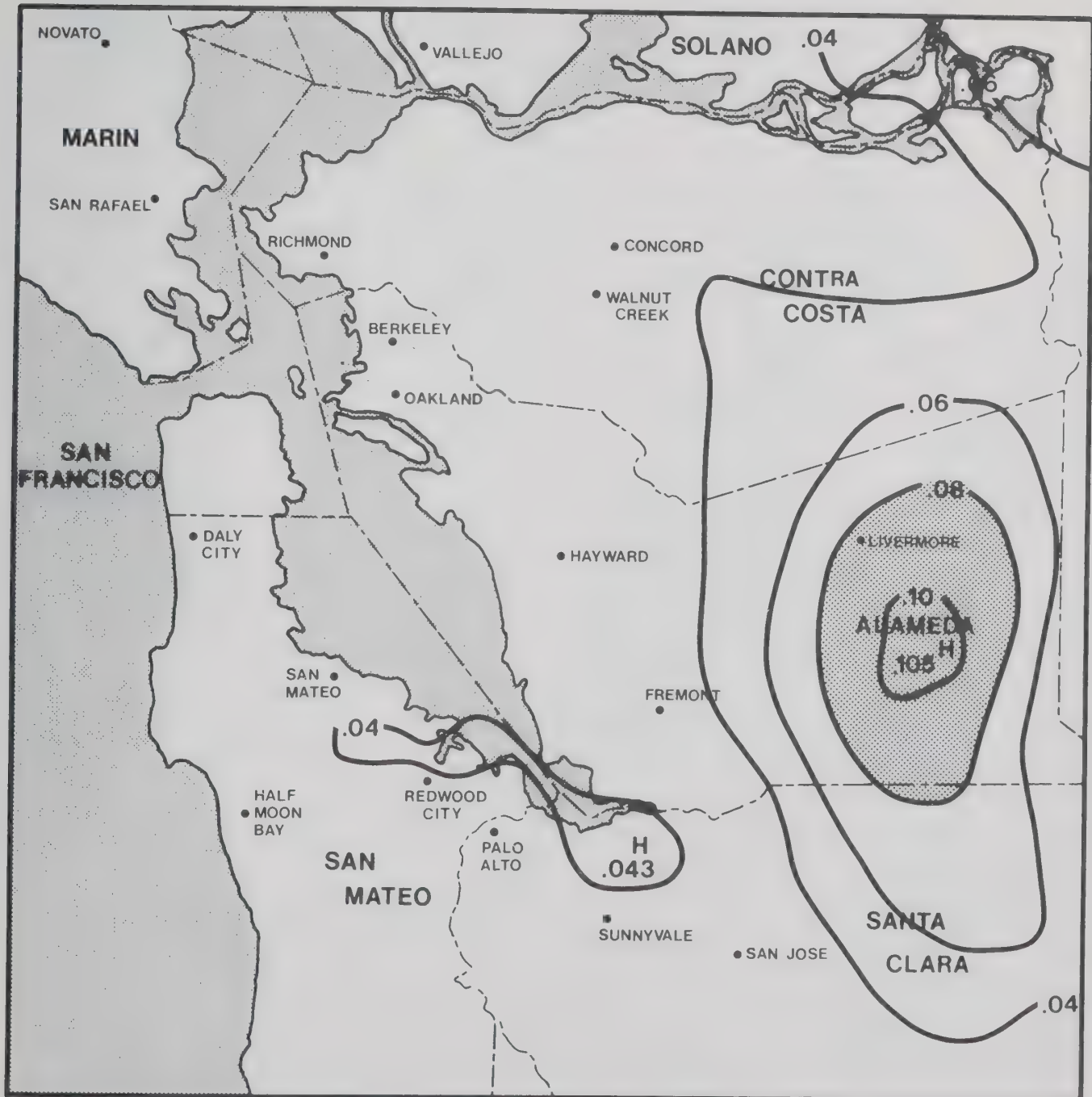
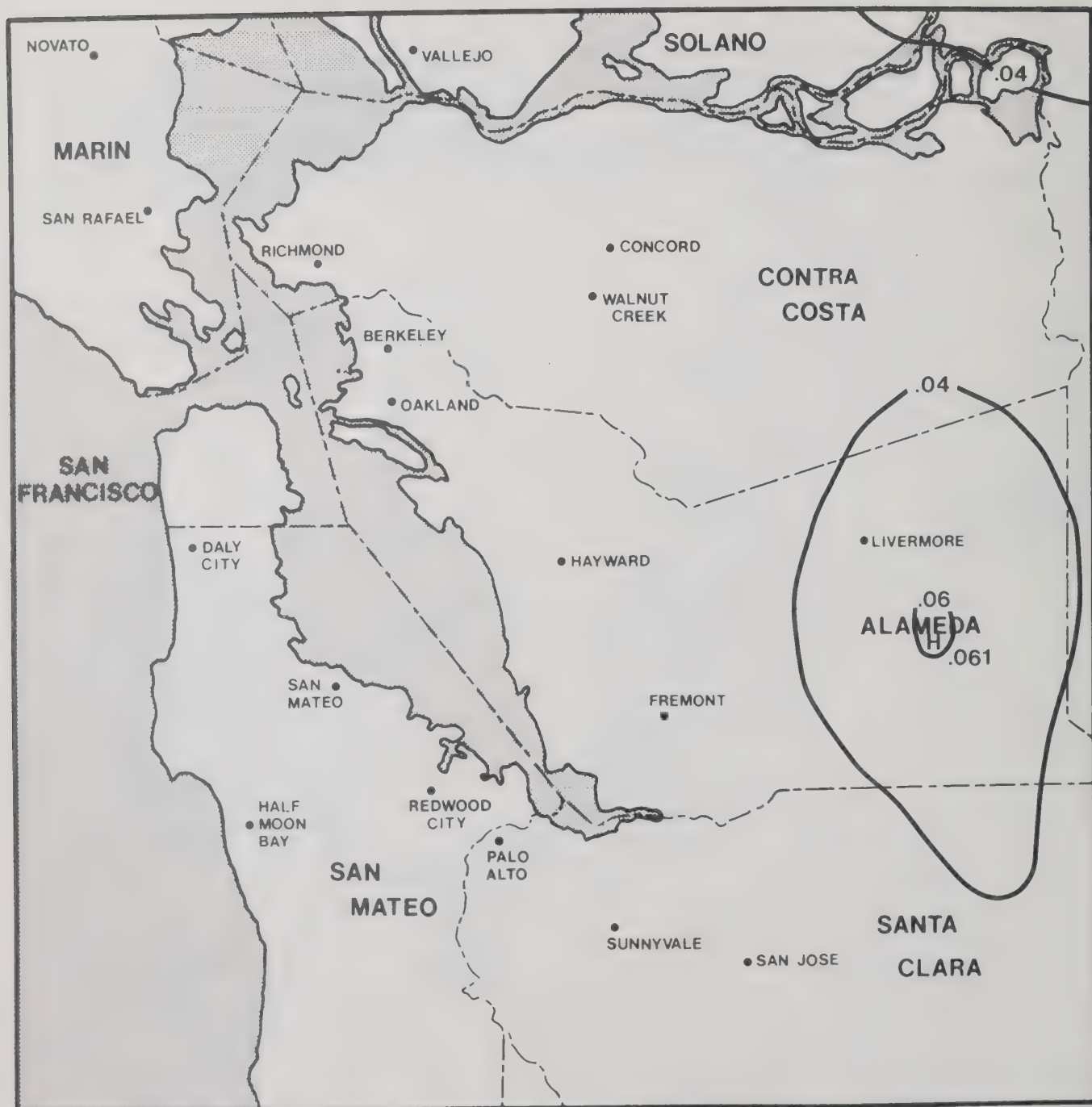


Figure C-6. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(20 Percent Hydrocarbon Reduction)



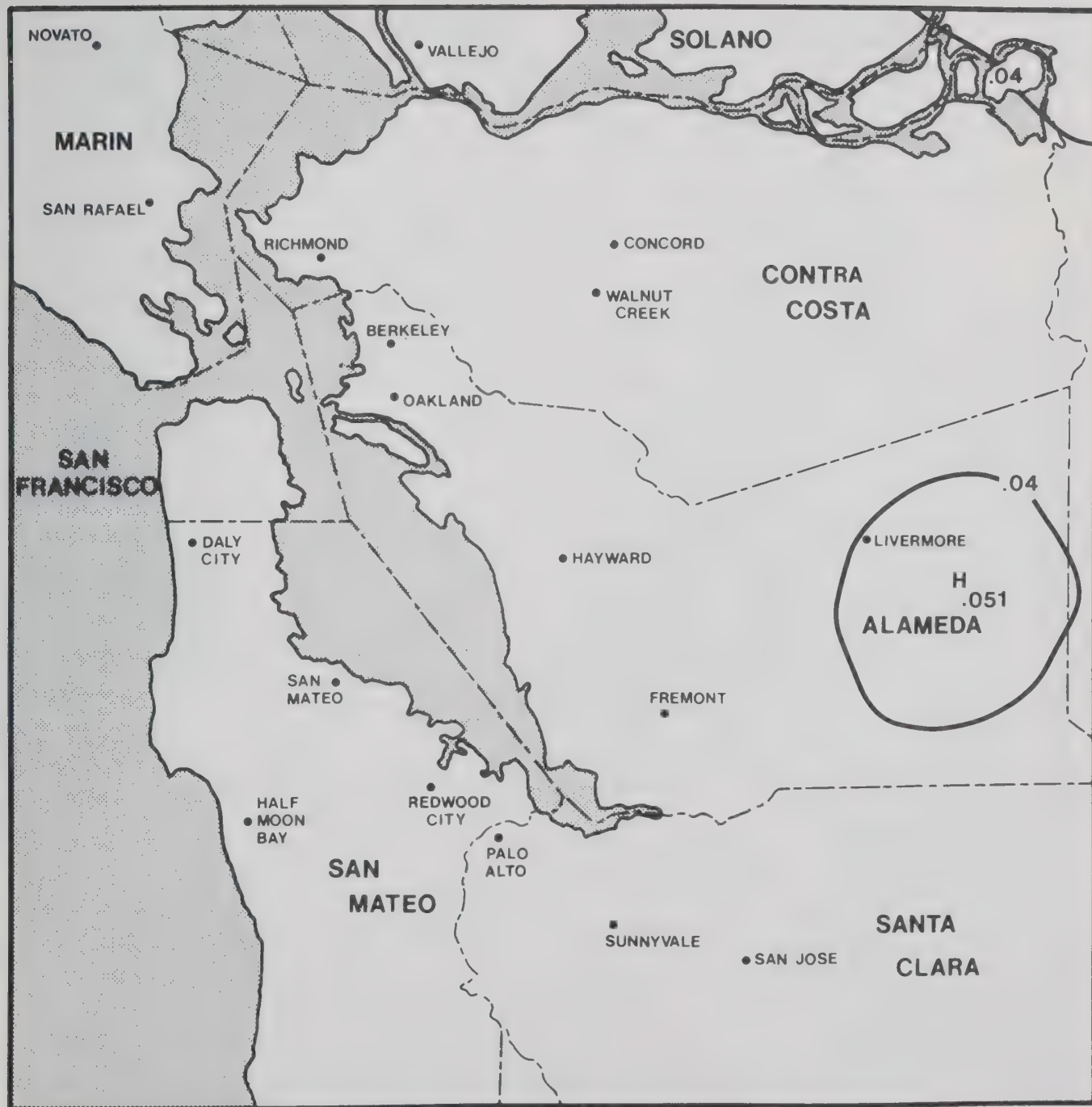
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 1985 baseline inventory

Figure C-7. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(40 Percent Hydrocarbon Reduction)



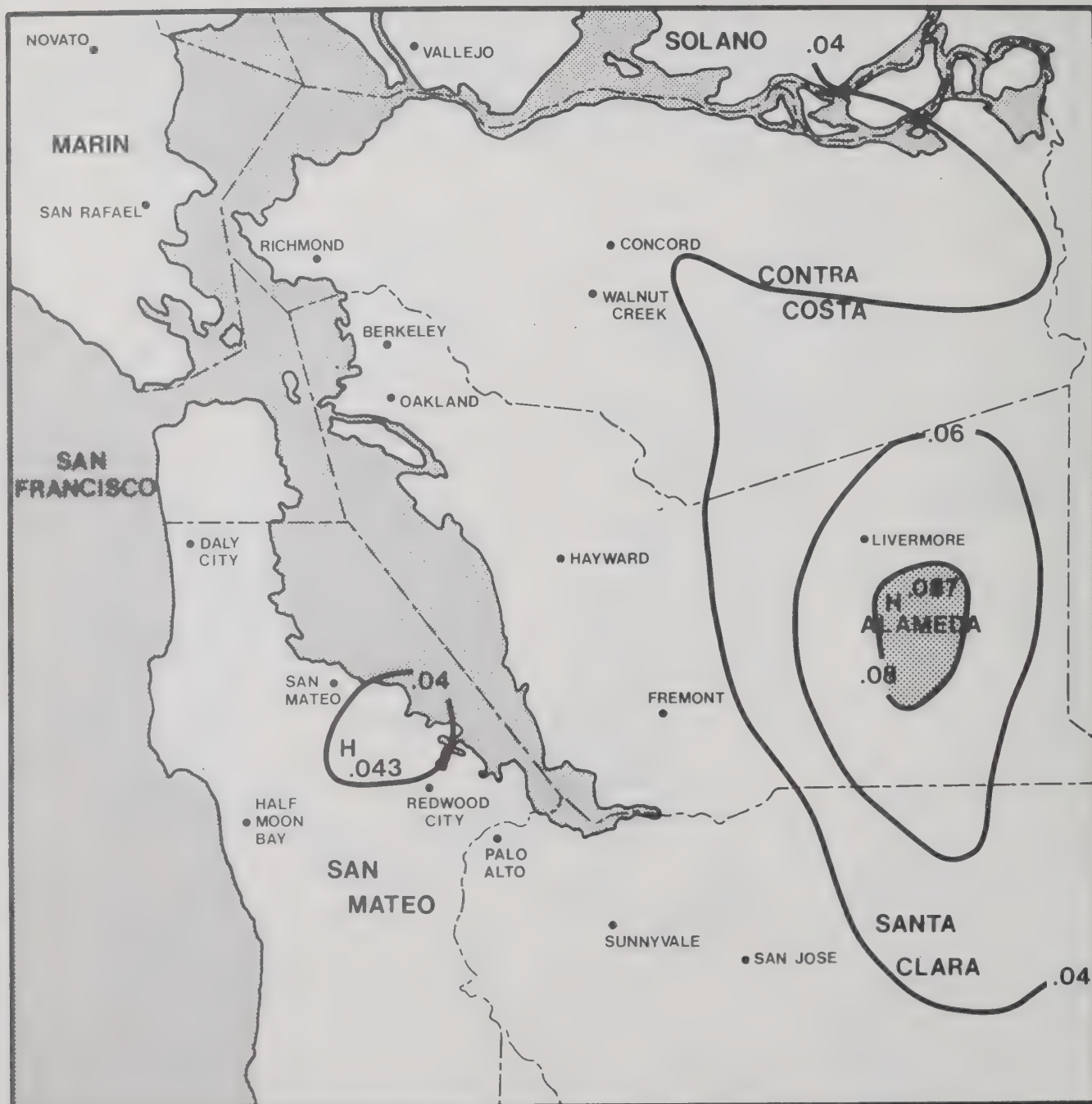
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 baseline inventory

Figure C-8. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(60 Percent Hydrocarbon Reduction)



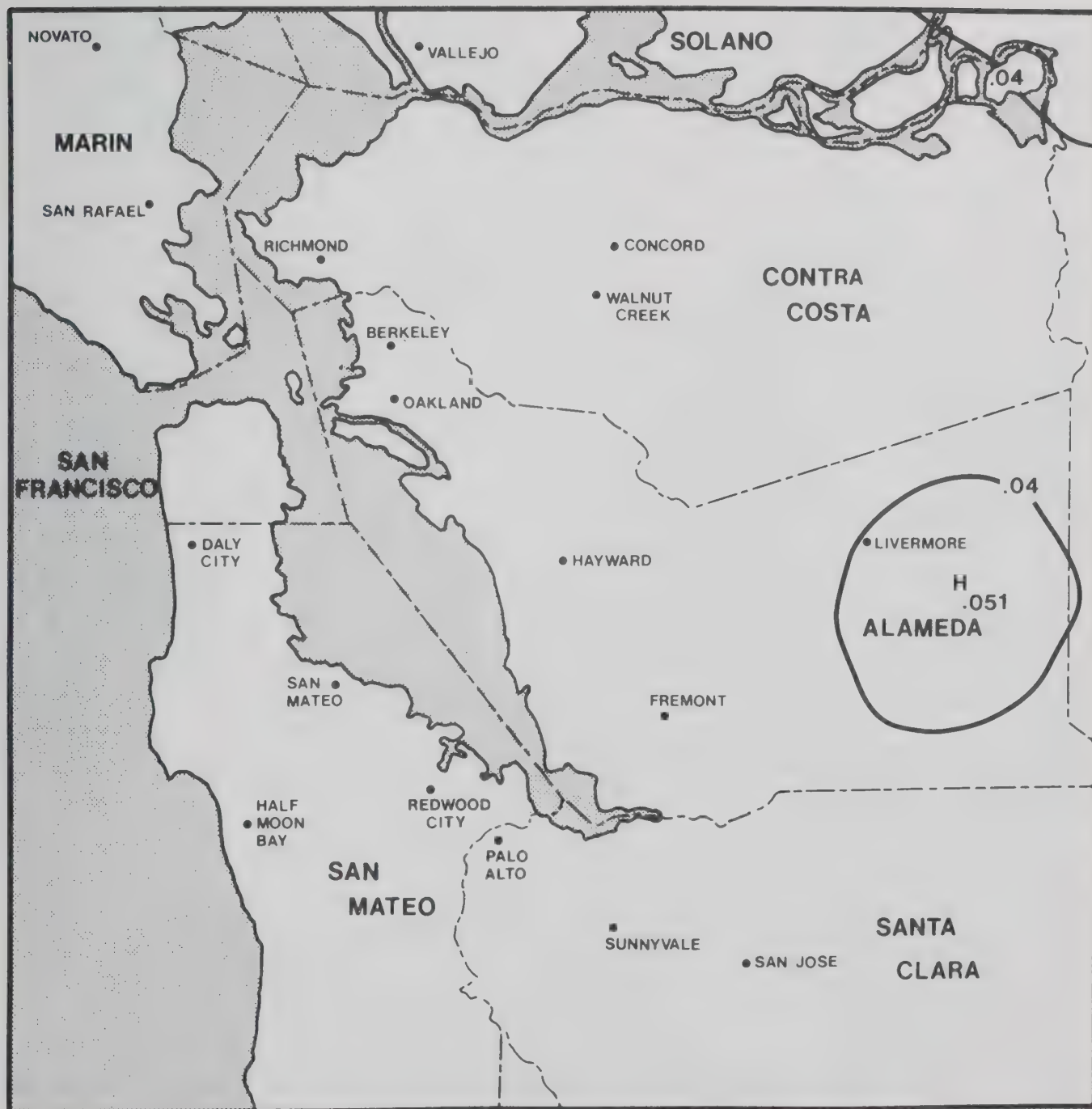
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 1985 baseline inventory

Figure C-9. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(40 Percent Hydrocarbon and 20 Percent Nitrogen Oxides Reductions)



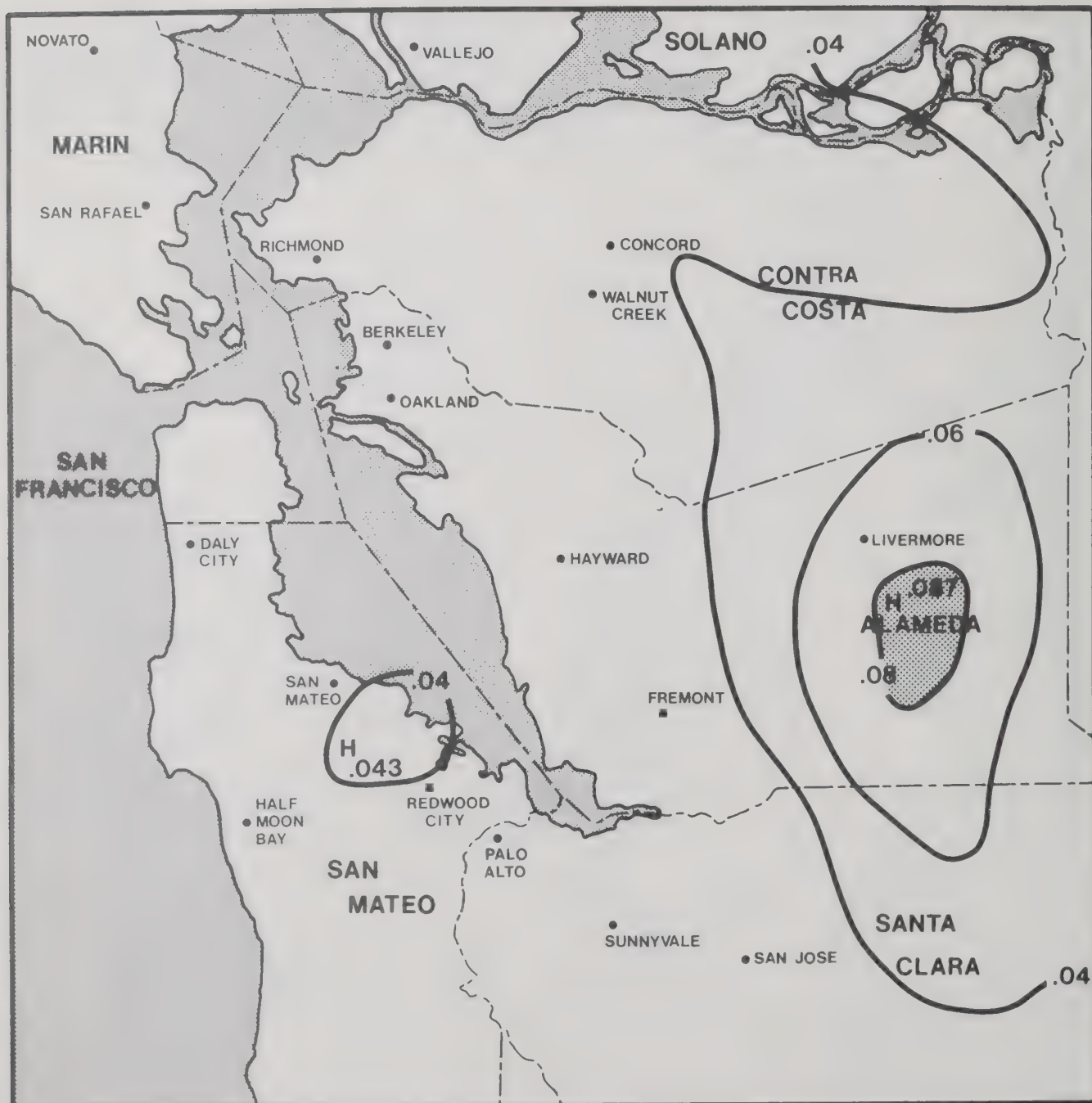
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 baseline inventory

Figure C-8. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(60 Percent Hydrocarbon Reduction)



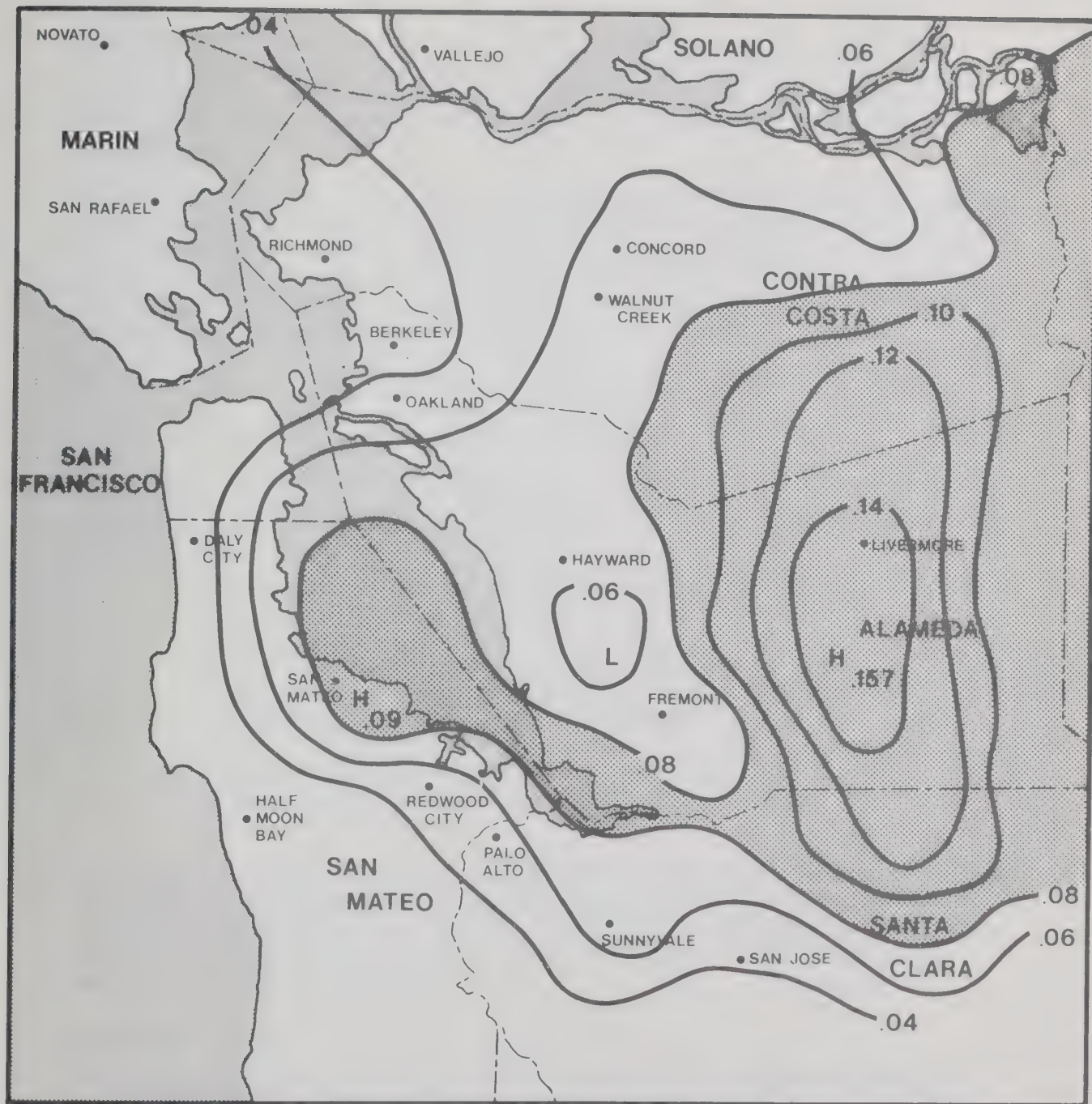
- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 baseline inventory

Figure C-9. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(40 Percent Hydrocarbon and 20 Percent Nitrogen Oxides Reductions)



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
 2) Values uncorrected for worst case conditions
 3) Emission reductions taken from 1985 baseline inventory

Figure C-10. Example LIRAQ Results - 1985 Ozone Sensitivity Analysis
(40 Percent Nitrogen Oxides Reduction)



- Notes: 1) July 26, 1973 Prototype Meteorology (1500 Hours PST)
2) Values uncorrected for worst case conditions
3) Emission reductions taken from 1985 baseline inventory

Appendix - D

Population, housing and employment projections used in the Air Quality Maintenance Plan

The population, housing and employment projections which were the basis for AQMP analysis included a high/low range of projected regional growth trends and a single projection related to an air quality "best case" termed the Compact Growth Alternative. The county level projections are documented in Table D-1.¹

The Compact Growth Alternative represents a different pattern of land development than would occur if the land regulation and service policies now in effect in local jurisdictions regionwide continue in force for 15 to 20 years. The land use measures described in Section 7 of this report could achieve the growth pattern described here.¹ This growth pattern is designed to achieve the following objectives:

- Reduce long distance auto commuting;
- Reduce auto trips and increase transit use.

To achieve reduced auto dependency the Compact Growth Alternative seeks to reverse three fundamental characteristics of development of the last 20 to 30 years:

- Shift the location of growth emphasis from outlying suburbs back to city centers;
- Bring housing and jobs throughout the region back into close proximity and toward a balanced mixture of housing and jobs in most jurisdictions;
- Increase permitted densities of new development toward the patterns common decades ago in many parts of the region.

These shifts in development represent a more precise statement of ABAG's 1970 city-centered Regional Plan and regional growth policies adopted by ABAG in 1973 and 1974. They also reflect the existing and emerging policies of many of the region's local governments, now being implemented on a piece-meal basis.

Amount of Growth

The projected county-by-county growth pattern to 1990 and 2000 is indicated in Table D-1, comparing housing, population, and job growth in the Compact Growth Alternative with high and low regional trends. Air

¹More detailed descriptions can be found in AQMP and ABAG technical papers listed in Appendix A.

quality analysis was based on the year 2000 projections and focused on comparisons of the low growth regional trend and the effects of compact growth on that same low growth level. The 1990 projections are included here for more ready comparison with the projections done by individual cities and counties.

The total regional growth examined in this Compact Growth Alternative is the same as the low trend for the region as a whole. This total growth is allocated around the region assuming more compact development at the urban fringe, more rebuilding within the cities, and higher zoning densities than now in force, especially in areas with transit service.

Shift of Growth Emphasis From Outlying Suburbs to City Centers

The AQMP Compact Growth scenario is premised on a shift in the location of new housing growth from the outlying suburban fringe to the existing cities of the region. As indicated in Table D-2, current local policy regionwide could accommodate slightly under 1/2 million new housing units within cities and their annexable areas, and about 1/3 that many units in more outlying suburban locations. This means that under current local policy about 3/4 of the new housing opportunities could locate in or near existing cities in the region. The 1/4 of the new housing opportunities that could locate in outlying suburban locations--and usually at very low density--would constitute the bulk of the problem for air quality. They would be largely automobile dependent and long distances from job opportunities. Even the close-in development, assuming current zoning, would likely be of such low density and so far from work and shopping locations as to be dependent on the automobile.

The AQMP compact development scenario assumes over 90% of new housing opportunities would be located in existing cities or close-in areas that can be annexed and provided with city services. About 2/3 of the new housing units could still locate in newly developing areas, but adjacent to the already built-up areas and at higher densities than currently permitted. About 10 % of the new housing could be located on scattered vacant sites bypassed by the suburban development of recent decades. About 1/4 of the new units would need to be added in rebuilding projects within the cities.

Balanced Growth in Housing and Jobs Throughout the Region

In order to reduce home-to-work commuting, the AQMP Compact Growth scenario assumes shifts in housing locations closer to existing and projected job opportunities. Thus jurisdictions that are most mis-matched now or in the regional growth trend, would be more balanced in jobs and housing by the year 2000. Marin County, for example, would yield more jobs and less housing in the Compact Growth Alternative so as to reduce out-commuting. Northern Alameda County would experience slightly greater job growth and substantial housing growth in the compact scenario so as to reduce in-commuting. The most notable reductions in out-commuting would occur in the Santa Rosa area, Fairfield, Pittsburg/Antioch, Pinole/Martinez, Richmond, Oakland, and South Santa Clara County.

Table D-3 compares projected jobs and housing growth in the AQMP Compact Growth Alternative with the regional trend in each county. Potential changes in net in/out commuting are also noted.

Higher Residential Density Would Be Allowed But Not Beyond Historical Patterns

The AQMP Compact Growth scenario is premised upon increasing densities in some locations beyond that currently allowed by local zoning. It does not suggest densities notably higher than now exists on the ground. The problem is that most local zoning densities are premised upon the development patterns of the post-1950 suburban development era. These densities are typically lower than the development of the 1920's and 1930's. This is especially true in the suburban communities.

In the older cities there is a trend toward "downzoning" of older developed areas to preserve neighborhood character by excluding new high density development. Adequate regulation of new development in or near older neighborhoods can preserve neighborhood identity while bringing greater diversity.

As indicated in Table D-4, the AQMP scenario suggests increasing densities for new development from a regionwide average of less than 3 dwelling units per acre to a regionwide average of about 6 dwelling units per acre. This would approach but still be less than the 8 dwelling units per acre that exists on the ground now. The existing regionwide density is notably influenced by the higher density of San Francisco. The typical in-city residential lot measuring 50' x 100' allows somewhat over 8 dwelling units per acre. The current regionwide zoning average lot size that would yield only 2.8 units per acre is the equivalent of about 1/3 acre per housing unit. Thus, the suggested return to densities of the pre - 1950 era does not imply massive high-rises. It means more apartments and more single family lots of city size rather than rural estate size.

TABLE D-1
COMPARISON OF PROJECTIONS
REGIONAL TRENDS and AQMP COMPACT GROWTH
(x 1,000's)

1990

COUNTIES	OCCUPIED HOUSING UNITS			POPULATION			JOBS		
	Regional Trends		Compact Growth	Regional Trends		Compact Growth	Regional Trends		Compact Growth
	High	Low		High	Low		High	Low	
ALAMEDA	504.1	498.3	537.4	1199.3	1118.5	1201.2	526.4	503.4	503.6
CONTRA COSTA	301.4	310.8	281.8	767.9	747.2	695.4	209.1	195.2	193.2
MARIN	106.8	105.1	98.7	277.3	257.8	234.3	65.1	61.8	63.2
NAPA	36.9	36.4	36.1	90.3	84.2	84.8	35.8	34.0	34.1
SAN FRANCISCO	319.1	316.4	320.9	643.3	607.0	617.2	603.2	586.4	586.8
SAN MATEO	273.6	267.3	296.1	668.2	623.1	675.5	273.9	260.1	260.1
SANTA CLARA	542.8	539.3	538.6	1389.8	1295.9	1276.5	749.8	707.1	708.2
SOLANO	104.9	111.3	91.6	263.0	255.6	223.8	72.1	67.2	65.9
SONOMA	133.7	133.4	117.0	326.4	294.7	275.2	117.8	92.3	92.5
REGION	2323.5	2318.2	2318.2	5625.4	5284.1	5284.1	2652.4	2507.6	2507.6

2000

COUNTIES	OCCUPIED HOUSING UNITS			TOTAL POPULATION			JOBS		
	Regional Trends		Compact Growth	Regional Trends		Compact Growth	Regional Trends		Compact Growth
	High	Low		High	Low		High	Low	
ALAMEDA	561.2	520.1	570.6	1284.3	1114.4	1217.1	553.1	507.5	508.8
CONTRA COSTA	318.2	324.0	291.6	799.6	759.6	690.9	228.4	198.8	197.3
MARIN	112.1	115.2	102.9	292.3	280.7	238.0	68.9	62.7	64.3
NAPA	41.2	40.1	38.2	102.0	90.8	86.5	40.4	36.6	36.6
SAN FRANCISCO	336.7	331.4	325.3	664.6	613.3	606.4	624.1	589.8	590.0
SAN MATEO	351.1	294.6	318.3	804.5	647.9	699.5	292.2	263.4	262.3
SANTA CLARA	593.2	556.6	583.2	1465.7	1281.9	1321.0	826.4	740.7	743.0
SOLANO	130.9	133.5	106.1	322.9	289.5	248.0	85.3	73.5	71.4
SONOMA	169.0	158.1	137.5	415.4	340.4	311.1	141.3	102.1	101.5
REGION	2613.4	2473.7	2473.7	6151.3	5418.5	5418.5	2860.1	2575.1	2575.1

TABLE D-2

CITY & SUBURBAN AREAS CAPACITY FOR NEW HOUSING
CURRENT LOCAL POLICY / AQMP COMPACT GROWTH

(x 1,000's of units)

<u>County</u>	<u>CURRENT LOCAL POLICY^{a)}</u>		<u>AQMP COMPACT GROWTH^{b)}</u>		
	<u>City Centered</u>	<u>Outlying Suburban</u>	<u>City Centered</u>	<u>Outlying After 1990</u>	<u>Suburban After 2000</u>
Alameda	64.1	25.0	256.1	14.2	1.4
Contra Costa	77.8	26.6	103.2	12.0	9.9
Marin	12.2	13.5	43.1	6.4	6.3
Napa	9.0	3.4	23.1	.8	2.4
San Francisco	10.5	-	37.4	-	-
San Mateo	22.6	10.5	203.3	7.4	2.2
Santa Clara	144.2	32.2	315.9	23.4	8.5
Solano	52.3	32.6	128.2	18.4	14.0
Sonoma	<u>59.4</u>	<u>13.0</u>	<u>220.7</u>	<u>2.7</u>	<u>9.4</u>
REGION	452.1	156.8	1,326.5	85.3	54.1

Notes:

a) Source: ABAG 1976 Local Development Policy Survey.

City Centered = land with services existing or committed and generally within LAFCO defined city spheres of influence. (In Sonoma, city plan areas; in Santa Clara, urban service areas.)

Outlying Suburban = locations usually outside city spheres of influence with low density zoning due to lack of sewer or water, slopes, flood plains, etc.

b) City Centered = same as above plus infill, rebuilding, higher densities in transit corridors; plus that land lacking only sewer or water service with that service assumed available by 1985.

Outlying Suburban = Same as above. All outside city spheres of influence.

TABLE D-3

JOB/HOUSING GROWTH AND COMMUTING
LOW GROWTH TREND / AQMP COMPACT GROWTH

<u>County</u>	Year 2000 JOBS (x 1,000 Jobs)		Year 2000 HOUSING (x 1,000 Units)		Year 2000 COMMUTING ^{a)} (x 1,000)	
	<u>Regional Trend</u>	<u>Compact Growth</u>	<u>Regional Trend</u>	<u>Compact Growth</u>	<u>Regional Trend</u>	<u>Compact Growth</u>
Alameda	507.6	508.8	520.1	570.6	-48.4	-81.0
Contra Costa	198.8	196.9	324.0	291.6	-122.1	-105.0
Marin	62.7	64.3	115.2	102.9	-56.1	-49.7
Napa	36.6	36.6	40.1	38.2	-3.9	-3.0
San Francisco	589.8	589.9	331.4	325.3	+240.7	+242.1
San Mateo	263.4	262.3	294.6	318.3	-77.1	-93.0
Santa Clara	740.7	743.0	556.6	583.2	+128.1	+126.4
Solano	73.5	71.4	133.5	106.1	-33.6	-20.7
Sonoma	<u>102.1</u>	<u>101.5</u>	<u>158.1</u>	<u>137.5</u>	<u>-27.7</u>	<u>-16.1</u>
REGION	2,575.2	2,574.7	2,473.6	2,473.7	Not applicable	Not applicable

^{a)} Inter-county commuting. + indicates net number of in-commuters. - indicates net number of out-commuters.

TABLE D-4

RESIDENTIAL DENSITY
CURRENT POLICY / COMPACT GROWTH ALTERNATIVE
(Dwelling Units Per Net Residential Acre)^{a)}

County	CURRENT ZONING POLICY			AQMP COMPACT GROWTH		
	Total		Density of New Develop't 1975-1990	Total		Density of New Develop't 1975-1990
	On-Ground 1975	Density 1990		On-Ground 1975	Density 1990	
Alameda	9.3	8.2	5.7	9.3	9.6	10.7
Contra Costa	6.3	4.0	2.4	6.3	4.8	3.0
Marin	4.6	2.9	1.4	4.6	4.5	4.1
Napa	4.9	4.8	4.8	4.9	5.0	8.7
San Francisco	31.1	32.9	b)	31.1	33.4	b)
San Mateo	6.5	4.5	2.2	6.5	6.0	5.3
Santa Clara	7.4	4.6	2.3	7.4	7.5	7.7
Solano	7.1	4.8	3.4	7.1	5.8	4.3
Sonoma	<u>4.9</u>	<u>4.1</u>	<u>3.0</u>	<u>4.9</u>	<u>4.8</u>	<u>4.5</u>
REGION AVERAGE	8.0	5.4	2.8	8.0	7.4	5.9

Notes:

- a) In both cases the future densities represented are projections; countywide housing units/countywide developed residential land.
- b) San Francisco is a very special case due to both its unusually high density and to the preponderance of mixed uses; residential above commercial where the land is generally credited to the commercial use. New development is assumed to be consistent with existing on ground density and current single-family zoning where applicable. Considerable rebuilding is assumed to be in mixed use at very high density.



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Country	1970	1971	1972	1973	1974	1975
Algeria	1.0	1.0	1.0	1.0	1.0	1.0
Angola	1.0	1.0	1.0	1.0	1.0	1.0
Argentina	1.0	1.0	1.0	1.0	1.0	1.0
Australia	1.0	1.0	1.0	1.0	1.0	1.0
Austria	1.0	1.0	1.0	1.0	1.0	1.0
Belgium	1.0	1.0	1.0	1.0	1.0	1.0
Brazil	1.0	1.0	1.0	1.0	1.0	1.0
Canada	1.0	1.0	1.0	1.0	1.0	1.0
Chile	1.0	1.0	1.0	1.0	1.0	1.0
Colombia	1.0	1.0	1.0	1.0	1.0	1.0
Czechoslovakia	1.0	1.0	1.0	1.0	1.0	1.0
Denmark	1.0	1.0	1.0	1.0	1.0	1.0
France	1.0	1.0	1.0	1.0	1.0	1.0
Germany	1.0	1.0	1.0	1.0	1.0	1.0
Greece	1.0	1.0	1.0	1.0	1.0	1.0
India	1.0	1.0	1.0	1.0	1.0	1.0
Indonesia	1.0	1.0	1.0	1.0	1.0	1.0
Italy	1.0	1.0	1.0	1.0	1.0	1.0
Japan	1.0	1.0	1.0	1.0	1.0	1.0
South Korea	1.0	1.0	1.0	1.0	1.0	1.0
Madagascar	1.0	1.0	1.0	1.0	1.0	1.0
Mali	1.0	1.0	1.0	1.0	1.0	1.0
Mexico	1.0	1.0	1.0	1.0	1.0	1.0
Morocco	1.0	1.0	1.0	1.0	1.0	1.0
Netherlands	1.0	1.0	1.0	1.0	1.0	1.0
Nigeria	1.0	1.0	1.0	1.0	1.0	1.0
Poland	1.0	1.0	1.0	1.0	1.0	1.0
Portugal	1.0	1.0	1.0	1.0	1.0	1.0
Romania	1.0	1.0	1.0	1.0	1.0	1.0
Saudi Arabia	1.0	1.0	1.0	1.0	1.0	1.0
Spain	1.0	1.0	1.0	1.0	1.0	1.0
Sudan	1.0	1.0	1.0	1.0	1.0	1.0
Sweden	1.0	1.0	1.0	1.0	1.0	1.0
Switzerland	1.0	1.0	1.0	1.0	1.0	1.0
Taiwan	1.0	1.0	1.0	1.0	1.0	1.0
Tanzania	1.0	1.0	1.0	1.0	1.0	1.0
Thailand	1.0	1.0	1.0	1.0	1.0	1.0
Tunisia	1.0	1.0	1.0	1.0	1.0	1.0
Turkey	1.0	1.0	1.0	1.0	1.0	1.0
Uganda	1.0	1.0	1.0	1.0	1.0	1.0
Ukraine	1.0	1.0	1.0	1.0	1.0	1.0
United Kingdom	1.0	1.0	1.0	1.0	1.0	1.0
United States	1.0	1.0	1.0	1.0	1.0	1.0
Yugoslavia	1.0	1.0	1.0	1.0	1.0	1.0

